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Coburn Warehouse and Storage Company.
Miscellaneous Fire No. H-2483—Page No. 149.

The Tobacco Industry.

PART II.

TOBACCO PRIZERIES, STEMMERIES, MANUFACTORIES, ETC.

Construction and Arrangement.

Today the only class of risk wherein tobacco is handled the construction of which may be said to be standardized and to possess characteristic features is the **Stemmery.** And these Stemmeries are largely owned by foreign corporations, mark you!

What can be applied to Stemmeries in the way of construction can be applied to any risk in which tobacco is handled or manufactured. Necessary magnifications of course would be necessary in large manufactories, but the construction scheme and arrangement would be relatively the same.

In the first part of this paper appearing in the October issue, on

An Ideal Stemmery.

Front view of the Wilson North Carolina Branch, Imperial Tobacco Co. of Great Britain and Ireland, Ltd. One story building in foreground is the Dryer Building. Main Building in background.

pages 28, 30 and 31, were illustrated four interior views of "An Ideal Stemmery." Herewith are illustrated two exterior views and a ground plan of the same Stemmery.

An Ideal Stemmery.

Rear view of the Wilson North Carolina Branch, Imperial Tobacco Co. of Great Britain and Ireland, Ltd. Power House in foreground; Dryer Building to right; Main Building in background. Large elevated tank in picture contains one of the water supplies for the sprinkler equipment with which the plant is provided.

The characteristic feature of arrangement is in the isolation of the drying machine in a separate one-story building, a most excellent arrangement. Likewise is arranged the Power House.

The Main Building in which the tobacco is received, stored and stemmed, is three stories in height, of moderate area, walls of brick, floors and roof of plank and timber. Superexcellence is not reached in this kind of construction—mill—in this particular case as the floors are not self-draining and are pierced by stair and elevator openings, which are however protected by enclosures and automatic hatches. The risk is well equipped with automatic sprinklers.

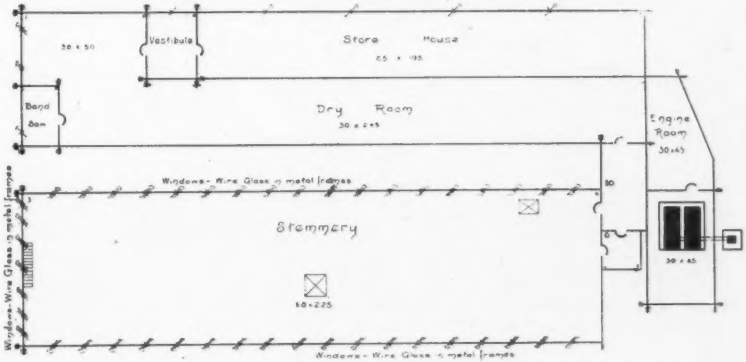
The same considerations as are hereinafter applied to warehouses, namely construction to be of minimum combustibility, moderation in area and height, etc., can well be applied to manufactories in a relative degree.

Standard Prizeries, Stemmeries and Manufactories should be of incombustible or standard slow-burning construction. Those of expert knowledge limit any one area to 10,000 square feet and height to four stories. A separate building similarly constructed should be provided for all drying machines. This building should be preferably detached from Main Building a moderate distance, and if attached,

properly cut-off. Likewise should be arranged the Power House, containing the boilers and engine.

Thus should a standard plant consist of a Main Building or Buildings in one or several fire sections—area of each not exceeding 10,000 square feet—openings in division walls properly protected by standard fire doors; a Dryer Building and a Power House.

Lighting, heating and power services, of whatever nature they may be—electricity and steam usually—should be installed in accordance with prevailing underwriters' standards.



Plan Showing Arrangement of a Modern Tobacco Stemmery.

Note.—Drying machine in separate building; also boilers and engines. This arrangement can be extended in magnitude and be applied to any property where tobacco is handled or manufactured.

TOBACCO WAREHOUSES.

Construction and Arrangement.

There are two general classes of tobacco warehouses, Sales Warehouses and Storage Warehouses. In the Sales Warehouses the tobacco changes hands from the grower to the dealer and manufacturer and in the Storage Warehouses it is stored by the manufacturers until it mellows sufficiently to be converted into salable product in the manufactories.

The stay of the tobacco in Sales Warehouses is but transitory, and as the leaf is moving in and out continually through the season there is not the same continued congestion as in the Storage Warehouses, where tobacco remains for two and possibly three years.

Sales Warehouses are generally of considerable area, walls of brick or wood, one-story in height with high gable roof. Much natural light is needed which may be furnished by large skylights in roof or by large windows in side walls. Artificial illumination may be from any of the well-known sources, gas, electricity, etc., but this is generally confined to the small area partitioned off for office purposes, as is also the heating which may be from steam or stoves.

As a general proposition Sales Warehouses should be of minimum combustibility. The average physical arrangement of prevailing types introduces much combustible bulk in the construction by reason of large area, high gable roof and wide span between supporting walls, all of which necessitates elaborate truss work. Roof trusses, if of wood, add much fuel for fire to feed upon and if of steel (unprotected) offer very little resistance to a moderate fire which even wooden trusses might resist.

Reinforced concrete could well be applied to this class of construction, and surely the additional investment in the increased cost of such construction would be worth while when it is considered that no other commercial commodity, handled in quantities like tobacco, has anywhere near the value per cubic foot and at the same time the high susceptibility to damage by fire, smoke and water.

Next in order of excellence would be so-called plank on timber construction with roof trusses of steel if need be, and such a building should be thoroughly protected by automatic sprinklers.

Incombustible construction and automatic fire protection will defeat the work of any "firebug."

As construction should be of minimum combustibility, likewise should the area be minimum. Subdivision of area is always a good thing anywhere. Those competent to judge agree that 15,000 square feet is the maximum for unbroken area in a Sales Warehouse.

As regards height, it is universally assumed that one story is sufficient and it is. No Sales Warehouse need be over one story high. The high gable roof has been established by custom, but it would seem that the "saw-tooth" form could well be applied in the construction of roofs of this class.

In fine, a standard warehouse of this class should be of minimum combustibility, minimum area and height and solely occupied for the sampling, temporary storage and sale of tobacco. Such a building should be comparatively isolated, and, if not, it should be protected against exposure fires by universally accepted methods. All details of service equipment and construction accessories should conform to standards in vogue.

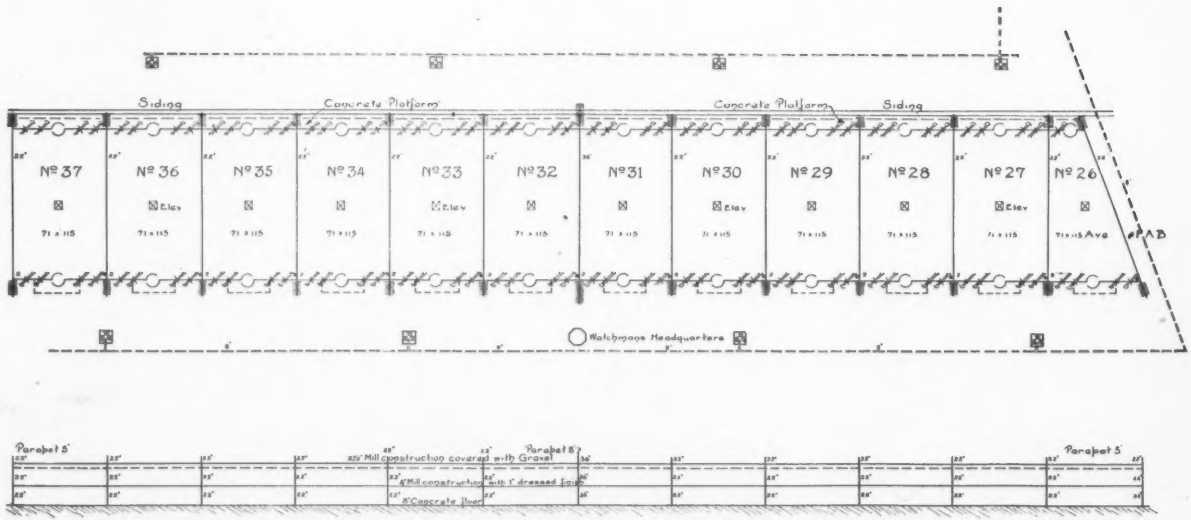
Storage Warehouses.—This is by far the most important class. In them great quantities of tobacco representing huge values, are stored for extended periods. More particularly in this class is it necessary that construction should be incombustible, area minimum, likewise height.

The character of construction of these warehouses has improved greatly within recent years, but the ideal has not yet been reached.

On the premises of a large tobacco manufactory in a southern city stand today warehouses of various types illustrating the respective degrees of progress in their construction.

First, a warehouse with wooden walls covered with sheet-metal, interior construction of light boards on joists, height one story, area moderate.

One of brick walls, with interior construction same as foregoing, height two stories, area considerable without subdivision; no floor openings.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Another of brick and similarly constructed, moderate area, but three stories in height with unprotected floor openings.

Of similar height and area is another warehouse, but construction of plank and timbers, floor openings, trapped; also same two stories.

The best of them all are the newest warehouses, which are two stories in height, walls brick, area moderate, floors and roof of heavy plank and timbers—mill construction—and without floor openings.

Even this does not represent the advanced type. The best tobacco warehouses of the day are of brick, divided up into sections of moderate area, 10,000 square feet is the maximum—no openings in subdividing walls—height one story; roof construction of plank and timber—slow burning or mill—and flat; floors of concrete on earth.

Storage Warehouses have to be freely ventilated. This is best done by means of flues in walls. Roofs should be unbroken.

Exposure fire should be guarded against by use of proper safeguards. Isolation is much the best.

The buildings should be used exclusively for storage purposes and should preferably not have any light and positively no heat or power of any kind therein, except—to be logical as regards power—that of the laborers. Light, if any, should be from a high-class electric equipment supplied by low-voltage direct current, wires in conduits.

More easily than in Sales Warehouses could reinforced concrete be applied in the construction of Storage Warehouses. Such construction would be ideal.

Herein are illustrated some of the best warehouses of the present day.

The class of Storage Warehouse herein discussed is strictly a manufacturers' warehouse and represents the most important variety having fixed and characteristic features. There are various other degrees of storage warehouses which might be fittingly termed Dealers' or Commercial Storage Warehouses as opposed to Manufacturers' Storage Warehouses. In them the line cannot be so finely drawn as in the warehouses of the superior type.

TOBACCO DRYING AND DRYING APPARATUS.

Tobacco has to be thoroughly dried of its content of sap, gum, oils, and what-not before it is in proper condition to keep without rotting when packed in hogsheads.

Today there are two general methods of drying, viz., by air and by artificial heat. In past times all drying was done in the former way and even now certain grades of tobacco can not well be dried in any other way.

In the application of artificial heat there are varied methods, but those of the present are all in the nature of blower systems moving steam-heated air, though different systems in use are variously modified.

The technology of drying and the advantages of blower systems for doing it are aptly explained in the following excerpt from a letter appearing in Insurance Engineering, July, 1906, as a reprint from Engineering News, November 17, 1898:

The Advantages of Blower Systems for Drying Materials.

The drying of any substance is simply the absorption from it of a portion of its moisture by means of a dryer surrounding medium. The natural method of drying is by placing the substance in the air and allowing the moisture to be absorbed by the air. The proportion of moisture absorbed will depend either on the amount of moisture already in the air or on the quantity of air present. Now, the amount of moisture that the air is capable of absorbing increases with its temperature, and the quantity of air depends on the size of the room relative to the amount of moisture in the article to be dried or on the current of air that passes by, absorbing and carrying off moisture as it goes.

Man soon learned that drying was facilitated by heat, and until within a few years the commonly recognized method of hastening drying has been by heating the air by steam pipes or otherwise, and thus increasing the capacity of a given volume of air to absorb moisture. A blowing fan accomplishes the same object by increasing the volume of air passing by the article to be dried and at the same time allows of better regulation.

Any drying, to be successful, must begin slowly and be hastened only when the inside of the article has become partly dry, in order to prevent cracking the surface or staining it by the coloring matter in the water dried out of it. If the surface of the article is made dryer than the normal air in which it is to be used, it becomes "dead" and brittle and will never regain its natural elastic condition. Overdrying is much more apt to occur if done by heat than by fan with air at normal temperature. Some thick articles, like brick or lumber, may require a certain degree of heat to start the moisture from the inside toward the surface, but thinner articles, like leather or tobacco, keep their elastic qualities better if dried at a low temperature, and this can only be done in all conditions of the atmosphere without moulding by a fan.

The secret of successful drying lies in the ability of the man who does it, not in the method. Some form of hygrometer is almost a necessity in the beginning, as the whole process of successful drying depends on the relative humidity of the air, or its substitute, regulation of quantity. In commercial drying, where the quantity of material to be dried is always placed in a comparatively small room, it is necessary to use heat or a fan to prevent moulding, but the principal consideration is time, and the intelligent use of a fan will do the drying in about half the time that would be needed with heat only, and leave the material in better condition.

Yours truly,

GIVEN & ALDRICH,
Civil and Mechanical Engineers.

Birmingham, Ala., Nov. 8, 1898.

The period of greatest evolution in tobacco drying apparatus has been within the last ten years. Previous to that time tobacco was dried in closed rooms heated by steam pipes to a very high temperature, 250° F. or so. The leaf to be dried was either hung or laid on trays on trucks. This method took about twelve hours and was accounted a great improvement over the old air-drying method which took six months. After drying was complete the rooms were opened and the tobacco allowed to cool, then the rooms were closed again and the leaf put in "order" for "striking" by humidifying the air therein

with steam jets. The entire operation of drying, cooling and ordering consuming about two days.

When the advantages of the use of blower fans for moving the drying air were understood, drying apparatus utilizing them was introduced. *The early dry rooms of this type were somewhat similar to the present form of Truck Dryer, described further on. Drying was completed in about seven hours. The trucks were withdrawn to allow tobacco to cool and then ordered in a closed room. In all, the complete operation took about thirty-six hours, the saving in time over the old method being in the drying. Also, this method did not require as high a temperature as the old method did. Improved forms of this type of dryer are in use today for certain kinds of tobacco.

Next to follow in the way of improvements were the early forms of the now perfected type of drying and ordering machines in which are complete the consequent operations of drying, cooling and "ordering." *The introduction of this type took place about ten years ago and its evolution has progressed through various experimental stages developing into the perfected machine of the present, which is very different from its progenitor of ten years ago. The time of the complete operation of drying, cooling and ordering in this type of machine varies from fifty to eight-five minutes approximately, according to the length and width of machine and manner of moving tobacco through machine. The temperature varies with the nature of leaf to be dried and with speed leaf is carried through the machine, as with very slow movement some leaf might be dried at a temperature as low as 130° F. Average working temperatures are about 165°-190° F. Maximum temperatures are used in drying "dipped filler" for plug tobacco, etc. These vary from 190°-210° F. and when fans are shut down in machines doing this class of work the temperature will rise as high as 230° F. and possibly more if not opened and steam shut off promptly.

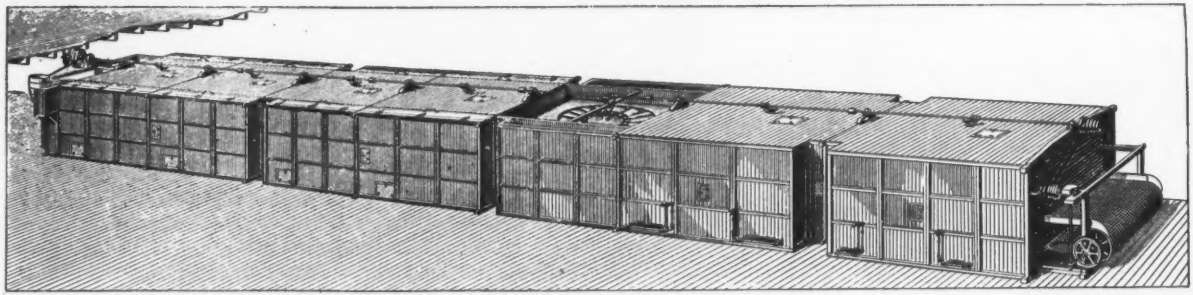
Tobacco drying apparatus of the present can be divided into two classes, namely: "Conveyor" drying machines, through which the tobacco is conveyed, while being dried, cooled and "ordered," laid on a wire apron or hung on sticks supported on chain gear; and "Truck" drying rooms in which are wheeled trucks loaded with tobacco laid on wire trays and which remain stationary until drying is completed. Aside from this classification there are types specially used, the Rotary and Reel dryers as of the Adt make, and also other forms used miscellaneously; all of which will be described.

"CONVEYOR" DRYING MACHINES.

Interior Circulation Types.

Machines of this type vary in manner of heating and moving drying-air. Most machines circulate the heated air within. In others the tobacco is dried by a continuous current of heated air blown in by

*The Philadelphia Textile Machinery Company, of Philadelphia, were probably the first to introduce these improvements in conditioning tobacco. Their apparatus is generally known as the "Proctor System."



Perspective View.

"Proctor" Apron Drying Machine. (Horizontal Fans.)

In general exterior appearance this machine is in all respects similar to the Stick and Combination types. In illustration machine ranges from left to right; Dry Section (four compartments) at left and in background, Cooling Section (fan showing) about in center, and Ordering Section (two compartments) at right in foreground. There are seven horizontal fans in this machine and the arrangement of the cooling fan as shown is typical of all the others. As regards accessibility to interior this illustration does not show latest method of arrangement of vestibules in coil spaces in Drying Section. In machine illustrated the first vestibule from left gives access into third compartment. Access to first, second and fourth compartments would have to be had by removing sections of panels, but even then direct access to space over apron could not be had. The vestibule second from left gives access into cooling section. In the Ordering Section is one vestibule which is arranged to give access into both compartments. This is the best arrangement and can well be applied to the drying compartments.

The flue shown as coming from projection at left-hand corner of machine serves to convey moist vapor away from first drying compartment; a special fan of small diameter is used for the purpose and in some very wide machines two such flues and fans are used.

In the Cooling Section the spaces outside of the fan serve as vents for the warm air to be disposed of and are extended by flues (of wood in most cases) outside of building. Similar spaces in Drying Section contain steam pipes (shown in illustration by hinged covers in top of machine at side). And such spaces in Ordering Section are used as spray chambers into which discharge the atomizers.

an outside fan and exhausted from the machine after use by another fan in some cases.

The **"Proctor System"** of tobacco drying and "ordering" machines manufactured by the Philadelphia Textile Machinery Company—and one time termed "Cyclone" dryers—are the most largely used of any class or type. In these machines the air within is circulated. The characteristic feature is in the steam pipes being at the sides within the machines instead of overhead as in other machines.

In general these machines consist of an **enclosure,** which contains everything incidental to the operation of drying; the **apparatus for drying, cooling and "ordering"** which is, **steam coils for heating** and **fans** (vertical or horizontal) for moving both the heated and cooling air and atomizers for moistening the air in the "ordering" section; and the **means for conveying** the tobacco through the enclosure, either an apron, chain stick gear, or both.

"Proctor" machines for drying, cooling and ordering tobacco may be divided into three classes.

First—The Apron Machine, adapted to drying dipped fillers, strips and leaf tobacco. In this machine the tobacco is spread on to a wire-cloth apron which carries it continuously through the various compartments of drying, cooling and ordering.

Second—The Stick Machine, adapted only to drying leaf tobacco in the bundle or hand. In this machine a roller chain conveyor, adapted to conveying tobacco sticks, is provided to carry the tobacco through while hanging on the sticks; a method very generally preferred by handlers of tobacco in the bundle, as it is claimed to bring the leaf out straighter and longer, due to being hung up during the entire process. This machine will not dry dipped fillers nor strips unless tied up in bundles.

Third—The Combination Stick and Apron Machine, adapted to drying leaf tobacco in the hand, strips in bundles, loose strips and dipped fillers. This machine is provided with a wire-cloth apron conveyor and above this a roller-chain conveyor for use in drying tobacco on sticks. It is, in other words, both an apron machine and a stick machine.

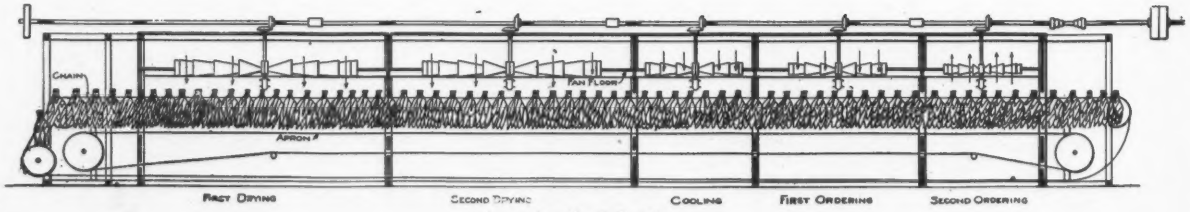
Except to dry dipped fillers or loose strips only, the combination machine has more features of advantage than either of the others, and combines all the advantages of both, and can be used either as an apron machine or as a stick machine.

The three classes of "Proctor" machines all have the following special points of interest:

The drying section is divided into two or more separate compartments, securing low temperature in drying, and at the same time capacity with lowest steam consumption.

The ordering section is also divided into two compartments, thus securing a low temperature for the ordered tobacco as it comes out of the dryer.

Enclosures are generally of wood, although in special cases partial coverings of sheet metal have been used. They are built of stout frames of timber which are panelled with removable sections of matched boarding. In the special cases referred to, the framework of the drying sections was covered with sheet metal.



Longitudinal Section.

Proctor" Combination Stick and Apron Machine, illustrating operation.

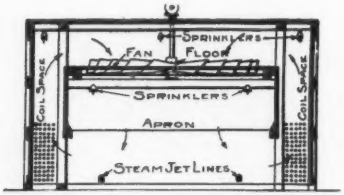
By courtesy of the Philadelphia Textile Machinery Co., Philadelphia, Pa.
Manufacturers of "Proctor System" Tobacco Drying Machinery.

Sizes of enclosures vary considerably in length and but little in width and height. The longest machine as yet built is one hundred and sixty-three feet and six inches in length and shortest thirty feet. The width varies from ten feet, eight inches to fourteen feet in average machines and those of extra width are eighteen feet in this dimension. Height ranges from eight to ten feet or so in apron and, or stick machines, and in special multi-apron machines the drying sections are about sixteen feet high.

Into three sections these enclosures are divided; first, the drying section; second, the cooling section; third, the "ordering" section. Drying and "ordering" sections are subdivided into compartments; drying sections into two, three, four, five and sometimes more in extra long machines; and "ordering" sections into two or three in ordinary machines, and perhaps more in larger ones.

These compartments are separated one from another by wooden partitions having openings therein just large enough to allow the passage of the tobacco.

The cross-sectional divisions of dryer enclosures arranged for horizontal fans are as follows: One vertical central section through which passes the conveyor apparatus; one or two other vertical sections at one or both sides, respectively, as the case may be, of aforesaid



Cross Section Through a Drying Compartment.

"Proctor" Apron Drying Machine, double size. Vertical fans both sides below apron. One inside bearing each fan, fan-shafts through steam coil spaces.

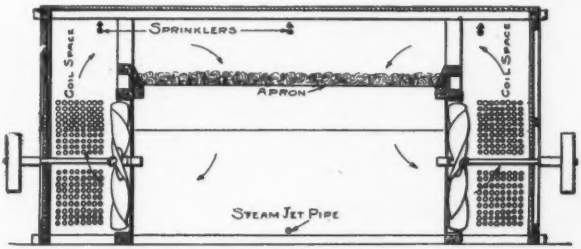
By courtesy of the Philadelphia Textile Machinery Co., Philadelphia, Pa. Manufacturers of "Proctor System" Tobacco Drying Machinery.

central section, these containing the steam coils in the drying end of machine, acting as air ducts in cooling section and in the ordering section as spray chambers into which the steam spray for moistening the air is directed; and one lateral section above central vertical section containing conveyor apparatus (and under roof of enclosure), which is used as an air circulating chamber. The horizontal partition dividing these sections is known as the "fan-deck" and in suitably arranged openings in this deck the fans, moving the drying air, revolve. The partitions dividing all of these sections are of wood and openings left therein for necessary circulation.

The cross-sectional divisions above and below the "fan-decks" are continuous throughout the machines. The section or sections containing the steam coils, etc., in modern machines are not continuous.

In the drying section proper they are interrupted at the end of each compartment by small vestibules opening outward which allow of access to interior of machines through small door openings. This arrangement progresses throughout the cooling and "ordering" sections in modern machines, thus making these side sections local at each compartment. In older machines in which this arrangement was not provided, and where the side sections were interrupted merely by partitions, access to the interior was quite difficult when the machines were in operation.

Cross-sectional divisions of machines using vertical fans are similar to those in foregoing type in general vertical arrangement, the main points of difference being that there is no fan-deck—the conveyor section being clear from floor to roof of dryer—and that the fans operate



Cross Section through a Drying Compartment.

"Proctor" Apron Drying Machine, double size. Fans horizontal. Main bearing inside. This is the average type of horizontal fan apron machine.

By courtesy of the Philadelphia Textile Machinery Co., Philadelphia, Pa. Manufacturers of "Proctor System" Tobacco Drying Machinery

vertically in openings in the partition or partitions, as the case may be, between the central conveyor section and the side section or sections, containing the steam pipes.

Drying apparatus proper consists of **steam coils** for heating and **fans** for circulating the air, which latter promotes absorption capacity. The steam coils are arranged in the sections on one or both sides of conveyor apparatus and supported independently of framework of enclosure, in this, the Philadelphia Textile Machinery Company or Proctor type of machine. It is claimed by the manufacturers that this method of arranging steam pipes eliminates the possibility of forcing the structure of dryer enclosure out of alignment which might cause machinery to run hard on bearings. This would possibly be if the considerable weight of the steam pipes was supported by the framework of the dryer itself. Also possible leakage from steam pipes on the tobacco is avoided. The coils are arranged in oblong angular banks, supported by an iron framework and set clear of woodwork at an ample distance. Steam supply pipes where passing through woodwork of enclosure are bushed through metal thimbles. Steam pipes sometimes are installed in "ordering" section as well as drying section.

Fans, Fan-Bearings and Shafting.

Fans are generally straight blades of metal, although wooden blades have been used in some old machines.

Fans vary in size, speed and arrangement. Horizontal fans range from 60 to 144 inches in diameter. Larger sizes make from 100 to 125 revolutions per minute; smaller sizes may run faster. Vertical fans are about 36-60 inches in diameter. Small fans run at a very high speed sometimes, possibly nearly 1,000 revolutions per minute. A 50-inch fan averages about 500 revolutions per minute and a 60-inch about 250 revolutions per minute.

Fan-Bearings have been the "bone of much contention," especially in connection with the horizontal type of fan. In the make of machine under discussion the bearing at present used is the result of effort made to overcome troubles experienced with early types. It is doubtless well understood by the reader that while there are two bearings supporting the vertical shaft of a horizontal fan, the lower has to support the weight and thrust of the fan as well as control its rotation, and is beneath the fan.

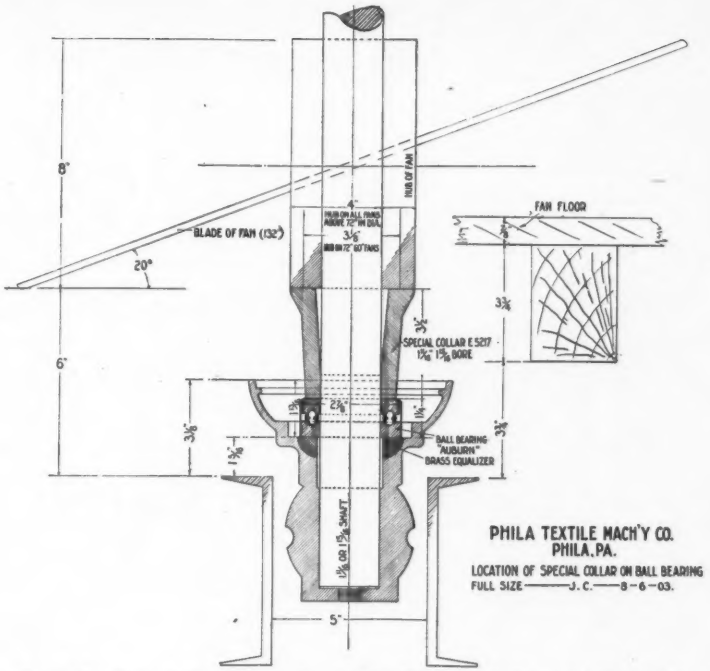
The first horizontal fan had a plain thrust bearing, not ball-bearing. This was improved by the addition of a simple type of ball-bearing and later on a special type of ball-bearing, known as the "Auburn," was used, but the desired results were not obtained until a self-adjusting collar was used for the "Auburn Ball-Bearing" to rest on with the effect that the bearing gets proper alignment and the load is evenly distributed on every ball in the bearing. (See illustration.) This self-aligning feature overcame all of the difficulties that had before obtained and no further trouble due to heated and hard running bearings was experienced.

Much trouble was had with the early types of bearings, especially the plain thrust bearing which heated up very easily. The addition of a simple form of ball-bearing did not help matters very much nor even did the use of a specially improved type. It was impossible to get a mechanically true alignment and one side of the bearing would get the thrust and load. The adjustable collar solved the problem and nowadays very little trouble, if any—and then it is generally the result of carelessness—is had with the improved self-aligning ball-bearing. These bearings are inside the dryer enclosure below the fan, although **there are special cases where the top of enclosure is especially arranged so that the bearings are outside.** (See illustration.)

Access for lubrication is readily had to these bearings through manholes in top of dryer enclos[illegible] at fan shafts and then through a handhole in hub disc of fan.

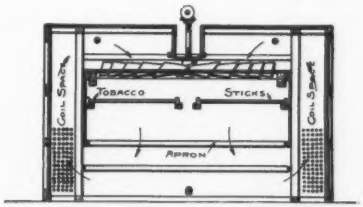
Support for the bearings is had between two six-inch steel channel beams which extend across the machine. These beams have special supports independent of framework of dryer enclosure.

Upper bearings of horizontal fans are generally of the ordinary journal type and are located above top of dryer enclosure. These are not subject to anything like the severe stress the lower bearings are. Likewise of the same type are the bearings, also on top of the dryer, supporting the driving shaft which runs over the dryer parallel with its longest dimension. These bearings are of the same type today as



Cross Section of Lower Bearing under Horizontal Fans in "Proctor" Drying Machines.

Note brass equalizing ring on which rests the "Auburn" Ball Bearing. This self-aligning feature has revolutionized the bearing hazard.



Cross Section through a Drying Compartment.

"Proctor" Combination Stick and Apron Drying Machine, double size. Fans horizontal. Roof of dryer enclosure specially arranged so that lower bearing is exposed. This is a special type of machine, made to conform to notions of underwriters.

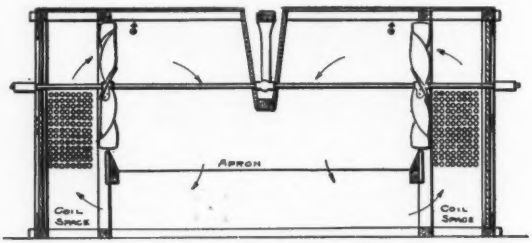
By courtesy of the Philadelphia Textile Machinery Co., Philadelphia, Pa. Manufacturers of "Proctor System" Tobacco Drying Machinery.

they have always been. No trouble is experienced with them where reasonable care is exercised.

Power is transmitted from prime mover to driving shaft by belt and pulley and from shaft to fans by suitably arranged bevel gearing. In all horizontal fan machines the fan driving shaft runs over the top longitudinally.

Vertical fan-bearings are of the ordinary journal type and very few changes, if any, have been made in them. Effort has been made to get them out of the dryer enclosure, which is as it should be. Vertical fans run at considerable speed oftentimes and with the bearings located inside the dryer enclosure they cannot be properly looked after. Consequently they lack proper lubrication and often run very hot, though not as much so as many suppose.

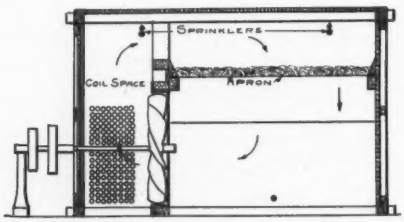
Herein are illustrated the different methods of arranging fans, each illustration being self-explanatory. The method of mounting



Cross Section through a Drying Compartment.

"Proctor" Apron Drying Machine, double size. Vertical fans both sides above apron. **Bearings of each fan so arranged as to be outside of dryer enclosure;** fan-shafts continuous across full width of machine.

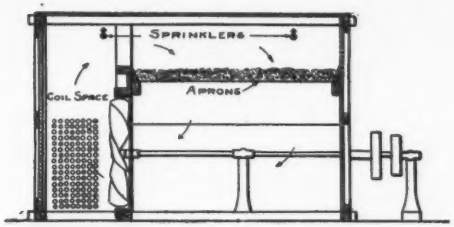
By courtesy of the Philadelphia Textile Machinery Co., Philadelphia, Pa. Manufacturers of "Proctor System" Tobacco Drying Machinery.



Cross Section through a Drying Compartment.

"Proctor" Apron Drying Machine, single size. Vertical fans below apron. One inside bearing each fan. Fan-shafts extend through steam coil space.

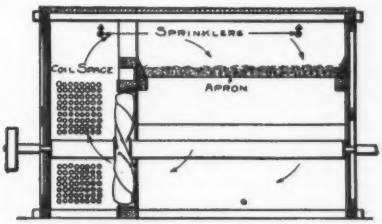
By courtesy of the Philadelphia Textile Machinery Co., Philadelphia, Pa. Manufacturers of "Proctor System" Tobacco Drying Machinery.



Cross Section through a Drying Compartment.

"Proctor" Apron Drying Machine, single size. Vertical fans below apron. Two inside bearings each fan. Fan-shafts extend across conveyor section of machine and extra bearings needed to steady shafts. This type is an early one and is not built nowadays.

By courtesy of the Philadelphia Textile Machinery Co., Philadelphia, Pa. Manufacturers of "Proctor System" Tobacco Drying Machinery.



Cross Section through a Drying Compartment.

"Proctor" Apron Drying Machine, single size. Vertical fans at one side under apron. **Outside bearings each fan;** fan-shafts of hollow boiler tubing, 4 inches in diameter, extend across full width of machine inside. Ends of hollow shafts are plugged and at these points necessary jointure is made with the solid shafting of smaller dimension which pass through walls of dryer enclosure and carry load on the bearings. **This is the latest improved type of single apron machine.**

By courtesy of the Philadelphia Textile Machinery Co., Philadelphia, Pa. Manufacturers of "Proctor System" Tobacco Drying Machinery.

fans on large hollow shafts of boiler tubing (about four inches in diameter) with the fan below the apron level and the bearings outside is the latest improved and has preference over all other systems in every particular, economy of operation as well as anything else. Power is transmitted to fan shafting by means of belts and pulleys running alongside machines.

Lubrication of bearings is perhaps the most important matter in operating drying machines. Automatic devices for accomplishing the

purpose have been found wanting. Manual application of lubricants at necessary intervals has been found most successful.

Many machines having horizontal fans have been equipped with gravity lubricators. These consisted of glass oil-cups located outside of dryer enclosures on tees connected with one-quarter inch pipes through which the lubricating oil was conveyed to the bearings. The height of the glass oil-cups was such as to be but slightly above the level of the cups of the bearings so the oil had but little head to cause it to flow through the pipes.

This method has not proved successful. The lubricating oil had to be of high viscosity and under the influence of the heat in the drying machines would gum and clog up the pipes continually.

The majority of operators of drying machines having horizontal fans have the bearing cups filled with a special grease before the day's run. It is claimed that no trouble is ever had from heated bearings when this is properly done.

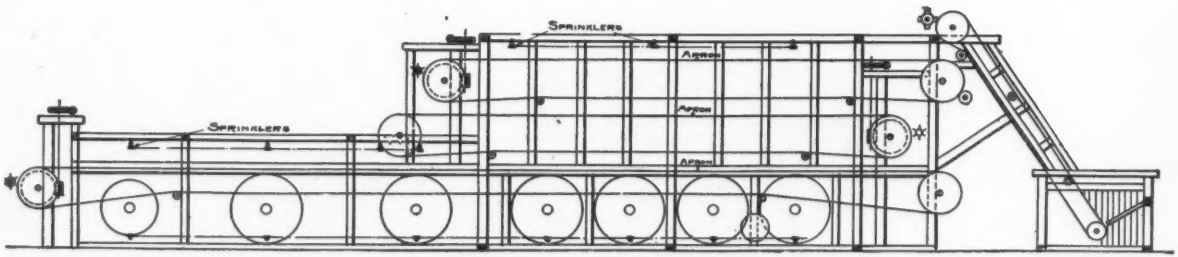
Bearings of vertical fans inside dryer enclosure are generally lubricated with grease, which is more properly viscuous in the high temperature of drying machines than oil is. The grease is "swabbed" in the cups cast in the bearings. Outside fan-bearings which are readily observable are often lubricated from oil-cups set on the bearings. Bearings of the ring oiling pattern are also used.

Unquestionably the bearings of all fans in drying machines are best located outside of the enclosures. This is especially so as regards vertical fans which revolve at high speed in bearings of the ordinary journal type. As regards the improved self-aligning ball-bearing of horizontal fans it is a question as to whether or not the hazard from it warrants such modification of the dryer enclosure as to have it outside. Certainly enough experience has been had with the improved self-aligning ball-bearing for horizontal fans in this particular make of machine to justify the contention of the manufacturers that there is nothing gained in distorting dryer enclosure so that bearings of this class may be outside. This of course opposes theory, but in practice, since experience justifies it, the hazard may be considered very remote.

Atomizers for humidifying atmosphere in "ordering" section of machine deliver a fine spray which is circulated by the fans. They are not of enough interest in this paper to warrant detail description.

Conveyor Apparatus consists of a wire mesh apron or chain stick gear or both, according to the kind of tobacco to be handled. Aprons are of wire about one-quarter inch mesh and continuous throughout the machine; arranged as an endless belt, passing over large wooden drums, one at each end of machine. These drums are driven by power, thus giving motion to the apron. Speed of aprons is about two or three feet a minute and sometimes faster, speed varying with the kind of tobacco and drying temperature. With average speed it would take about 50 minutes for the tobacco to journey through a machine 140 feet long, and with an apron 12 feet wide a machine of this size would dry about 2,500 pounds per hour.

Special machines with two additional aprons in the drying section only, superposed above the long apron, have been built particularly for drying "dipped-filler" tobacco in Plug Factories. At first the compartmental division scheme, as in the normal types, was attempted by

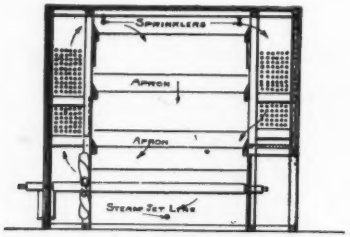


Longitudinal Section.

"Proctor" Multi-Apron Dipped Filler Drying Machine. This is a special design. Drying compartment in later machines is one large section without sub-divisions. In earlier machines attempt was made to divide it into two sections horizontally by putting in a lateral partition about 4 inches below top of intermediate apron.

By courtesy of the Philadelphia Textile Machinery Co., Philadelphia, Pa. Manufacturers of "Proctor System" Tobacco Drying Machinery.

laterally dividing the drying section into two compartments, upper and lower. In later machines this idea has been abandoned—which is a very good thing as much scrap tobacco collected on this horizontal partition and was very difficult to remove—so the drying section is one large section. Tobacco to be dried is dropped on top apron by means of a conveyor and is "doffed" from upper to intermediate apron and finally to the lowest or long apron which carries it through the cooling and "ordering" sections. (See illustration.)



Cross Section through a Drying Compartment.

"Proctor" Multi-Apron Drying Machine. This is a double size special machine with three aprons in drying section. Designed for drying dipped filler tobacco. Fans vertical, under aprons; bearings outside. Fan-shafts of 4-inch hollow boiler tubing, extend across machine.

Some older machines of this type have been made with fan-shafts through and under steam coil spaces with one inside bearing each fan.

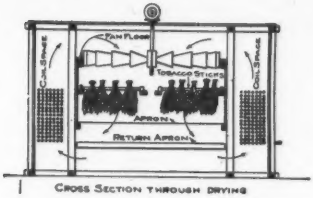
By courtesy of the Philadelphia Textile Machinery Co., Philadelphia, Pa. Manufacturers of "Proctor System" Tobacco Drying Machinery.

Chain gear for carrying sticks in the so-called "Stick" or "Stick and Apron" machine is in form of endless chains running over toothed wheels actuated by power, at both ends of machines. These chains are supported in their length on longitudinal wooden ways. In wide machines, as for example a twelve-foot apron machine combined with the stick drying method, the stick gear is double, making four chains in all. These machines are termed double and the poles each side for carrying the hands of tobacco are about five feet long.

These "Proctor" machines, as manufactured by the Philadelphia Textile Machinery Co., constitute over 80% and possibly nearly 90% of all tobacco drying machines in use.

The Operation of the "Proctor" Drying Machine is—varying with manner of handling tobacco in machines, i. e., on sticks or on aprons—as follows:

As the tobacco enters the first compartment of a stick machine (see illustration) it comes in contact with a blast of warm air directed downward by the fan overhead. Passing slowly through, the tobacco is relieved of much of its moisture. The heavy moist air is exhausted from the compartment by means of a special exhaust fan.



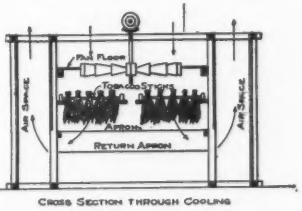
Cross Section through a Compartment of Drying Section.

"Proctor" Combination Stick and Apron Machine showing operation.

By courtesy of the Philadelphia Textile Machinery Co., Philadelphia, Pa. Manufacturers of "Proctor System" Tobacco Drying Machinery.

The temperature in this first drying compartment is generally about 165° F., that in the second or other compartments between first and last drying from 175° F. to 190° F., and in last compartment before cooling section it is as low as 140° F.

Having passed through the several compartments of the drying section the tobacco enters the cooling section (see illustration) where



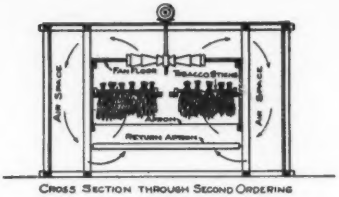
Cross Section through a Cooling Compartment.

"Proctor" Dryer, showing operation.

By courtesy of the Philadelphia Textile Machinery Co., Philadelphia, Pa. Manufacturers of "Proctor System" Tobacco Drying Machinery.

it is thoroughly cooled before going into "ordering" section. The cooling is effected by leaving top of dryer enclosure open, the fan inducing a draft of cool air through the opening and blowing it on the warm tobacco. The heat laden air passes up through flues at sides of cooling section and out into the open air.

Passing on, into and through the two or more compartments of the "ordering" section (see illustration), the tobacco absorbs moisture from the humid atmosphere therein which puts it in proper condition for handling and packing. The air is humidified by steam and water sprays and is circulated by the fans which keep beating it down on the tobacco in the first "ordering" compartment and drawing it up through the leaves in the last. The temperature in this section varies between 110° and 120° F.



Cross Section through an Ordering Compartment.

"Proctor" Dryer, showing operation.

By courtesy of the Philadelphia Textile Machinery Co., Philadelphia, Pa. Manufacturers of "Proctor System" Tobacco Drying Machinery.

In plain apron machines, whether the fans are overhead or at sides, the drying air is drawn or blown up through the tobacco in the first compartment of the drying section, also in the cooling section and in the last ordering compartment. In all other compartments the air is directed downward. The upward passage of the air through the tobacco on the apron tends to loosen it up and allow freer circulation of air.

The "Hurricane" tobacco drying machine manufactured by The Philadelphia Drying Machinery Company, is another of the interior circulation types in the "Conveyor" Machine class.

In general arrangement this make of machine resembles that previously described, the characteristic points of difference being—more particularly in recent machines—as follows:

Steam pipes in horizontal fan machines located above fans in space between fan deck and top of dryer enclosure, and supported by steel beams.

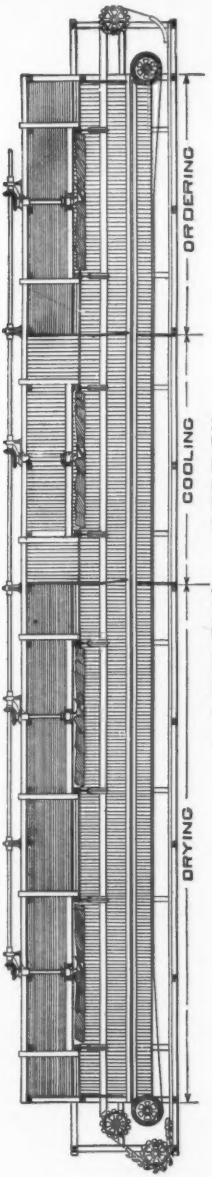
Lower Bearings in horizontal fan machines are **above** fans and arranged so as to be outside of enclosure by V-shaped depression in top of same, which extends full length of machine. The lower bearings are in the bottom of the trough the bottom of which is just above fan decks. This effects a lengthwise division in the steam pipe compartment above fan deck, so the steam pipes are arranged on both sides of it in the drying and ordering sections, the latter, if steam pipes are installed there.

This arrangement—also used in special machines of make previously described—removes bearings from direct action of heat in dryer enclosure and from the dust therein.

The lower bearings are ball-bearing and those supporting line or drive shaft above machine are of ring oiling pattern.

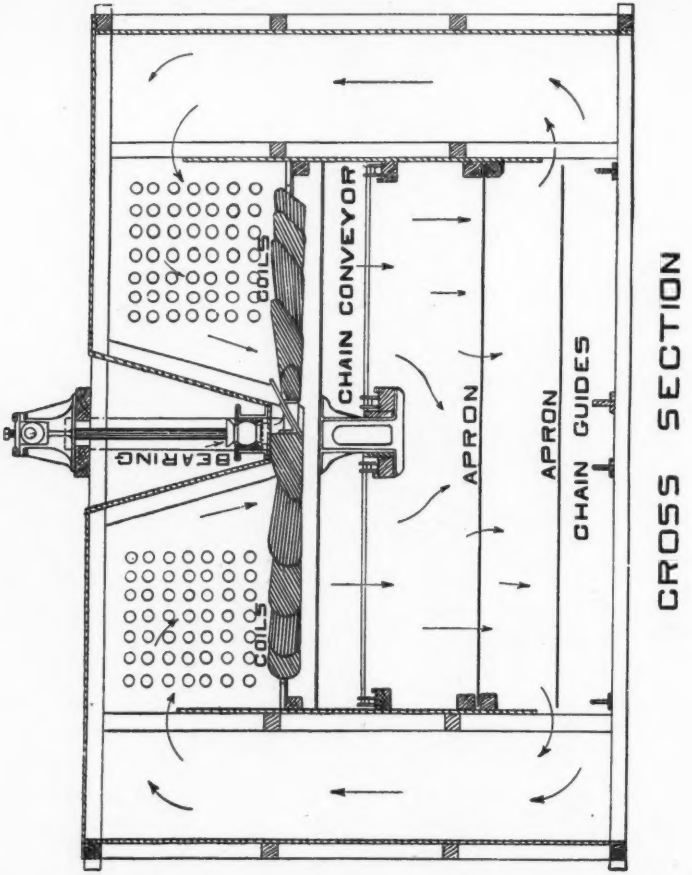
This machine is being actively pushed in the market and its use is being extended.

Another of the types of this class is the so-called **"Economy"** dryer manufactured by Mayo-Hysore & Co. of Richmond, Va. This machine is not now actively pushed in the market and its manufacture, it is said, has been practically abandoned; machines are made, if any, only on special order. In the early days of patent drying machines



"Hurricane" Tobacco Drying Machine.

By courtesy of The Philadelphia Drying Machinery Co.



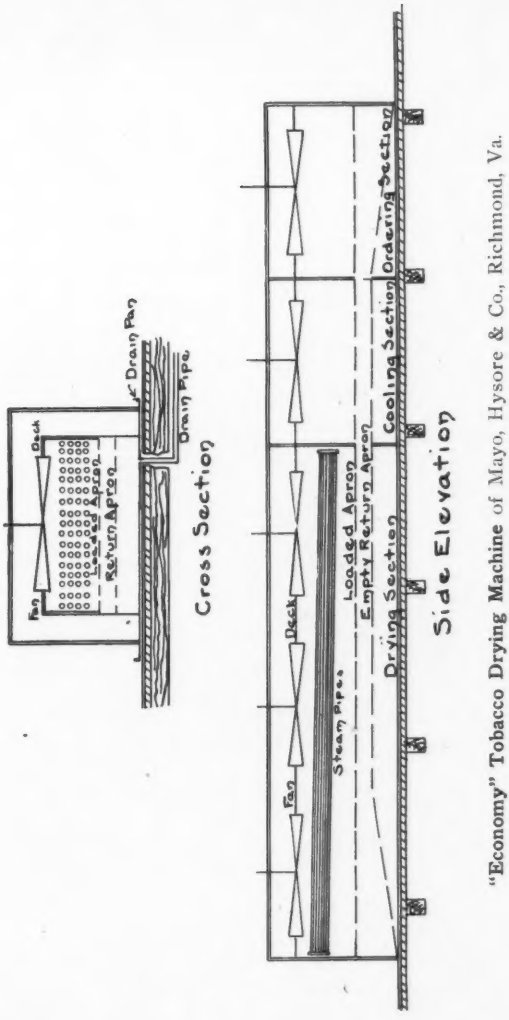
"Hurricane" Tobacco Drying Machine.

Note arrangement of top of enclosure allowing all bearings to be outside.
By courtesy of The Philadelphia Drying Machinery Co.

this make was an active competitor of the "Proctor" or as it was termed then, the "Cyclone" machine of the Philadelphia Textile Machinery Company.

The salient points of difference in the Mayo-Hysore machine from the "Proctor" are:—

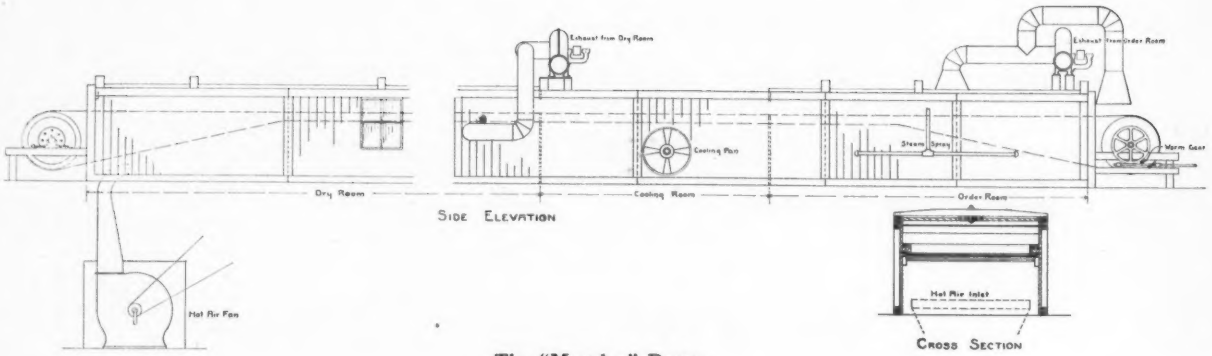
Steam pipes or radiator located in conveyor section of dryer enclosure below fans and above apron and extend full length of drying section of machine, and so pitched that the steam pipe header or trom-



"Economy" Tobacco Drying Machine of Mayo, Hysore & Co., Richmond, Va.

bone at point of entry into drying section is up near fan deck and that next cooling section at end of drying section is just above apron; this permits of proper drainage, but brings ends of steam radiator rather close to fan deck and apron respectively.

These machines are altogether of the horizontal fan type. The lower bearings are below the fans and are generally of the plain thrust bearing type.



The "Moseley" Dryer.

An example of the Exterior Circulation Conveyor Drying Machine. Blower fan and steam coils are, in connection with this machine, located on floor below. In other types, fans and coils may be located at side of machine.

Drying and "ordering" sections are not sub-divided into compartments. Otherwise general scheme of enclosure is relatively the same as that of the "Proctor" machine, except that access is had to interior of machines through large doors in side walls located at frequent intervals.

Some of these machines had a rope transmission drive for fans which ran longitudinally above top of machine. Most of the machines, however, had the line shaft bevel gear drive for fans.

Many of these machines, as has been stated to the writer, have been overhauled and arranged differently from manner in which they were initially installed.

Exterior Circulation Types.

In these machines of the conveyor class the drying air is heated outside of the dryer enclosure. The air is drawn—generally—through a nest of hot steam pipes by a large fan which, after the air is heated, forces it through flues into the dryer. The moisture laden air in the machine is exhausted by another and smaller fan.

The general scheme of these machines is similar to that of the interior circulation types. The enclosures are divided in their length into drying, cooling and ordering sections, but the cross section is different, the machines being only a bit wider than the conveyor apron, and without side sections; also not as high as the other types. The absence of steam pipes in the enclosures allows of less width and height. The temperature in these dryers is somewhat lower as a general rule than it is in machines in which the drying air is recirculated.

The drying section in machines of this type may or may not be divided into compartmental subdivisions. The cooling section has special fans in exterior walls and warm air is driven off through top. Circulation in the ordering section is induced by a special fan exhausting air therefrom.

Chief among these machines is the "Perfection" dryer of The Moseley Dryer Company of Richmond, Va. The "Goodwyn" machine is also of this type.

Drying machines of the exterior circulation type are not universally used and but few are in service.

"TRUCK" DRY ROOMS.

This manner of drying tobacco is the survival of an early form antedating patent machines. The arrangement of the present day dry rooms is of course radically different from that of early days.

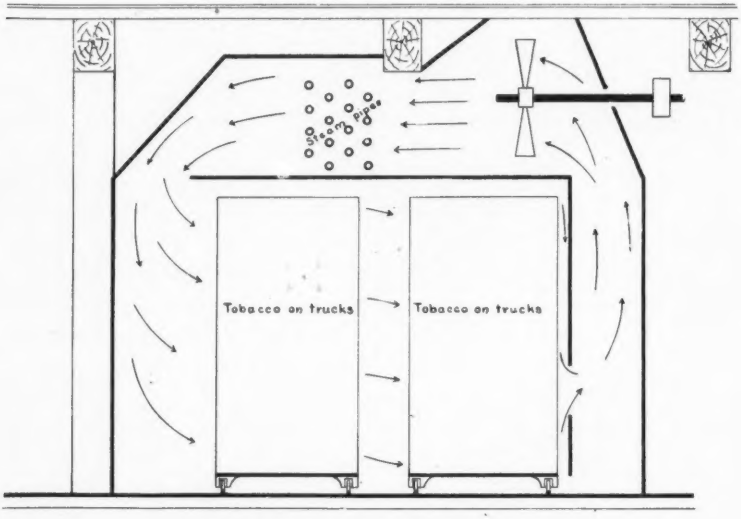
The feature differentiating this from the conveyor machine class is that the tobacco to be dried is not kept in motion through the enclosure but remains in it quiescent during drying period. Otherwise "Truck" Dry Rooms have relatively the same features as drying machines, with, of course, some considerable modification of arrangement.

In drying tobacco by this method the operations of drying, cooling and ordering are not continuous throughout one enclosure. After dry-

ing in one of these rooms the tobacco is withdrawn and allowed to cool and then "ordered" in a special room, in all respects similar to the dry room, the only difference being that steam atomizers take the place of steam pipes and the fans circulate the vapor instead of heated air.

The use of Truck Dry Rooms is confined chiefly to conditioning Cigar Leaf Tobacco although they are considerably used in certain Virginia districts. As in the conveyor machine class they may be divided into two sub-classes, those having **interior circulation** and those having **exterior circulation.**

Chief among **Interior Circulation Truck Dry Rooms** is that shown in illustration. It is the most modern form and especially adapted to handling Cigar Leaf. The "room" consists of an enclosure to contain



"Truck" Dry Room. (Interior Circulation.)

Cross section of a modern type of this class of tobacco dryers. Width as shown is practically same in all rooms, also height; length varies according to capacity desired, some rooms having five or six fans, which are spaced about 7 feet on centers, one to every two trucks. Tobacco is laid on trays supported in racks on trucks.

tobacco to be dried and for confining the drying air; steam pipes for heating and fans for circulating drying air. Enclosures are of wood, matched boarding or studding. Dimensions are, as were observed in one case: width, 13 feet, 9 inches; height, 12 feet; length, 37 feet. Width and height in other rooms of this type will not vary much from these dimensions, but length may.

Inside, the enclosure is laterally divided into an upper and a lower section which extend throughout length of machine, by a horizontal

board partition about eight feet or so above floor. The upper section contains steam pipes and fans, the lower the loaded trucks of tobacco. Between trucks and sides of room there is a clearance of two feet or so to permit of circulation and between the trucks themselves about a foot, side to side. The main lateral partition is open at walls of room to allow passage of air.

The steam pipes are located a little to one side of the center and are securely arranged in an iron rack and extend throughout length of room.

The fans are set in circular openings in a partition which runs through upper section near one side. Fan shafts extend through wall of room and are belt-driven. Inside end of shaft is supported in one bearing of the ordinary journal type, ring-oiling in some cases. The other shaft bearing is outside. Fans are about three feet in diameter, blades of metal, and revolve about 400 revolutions per minute, sometimes more.

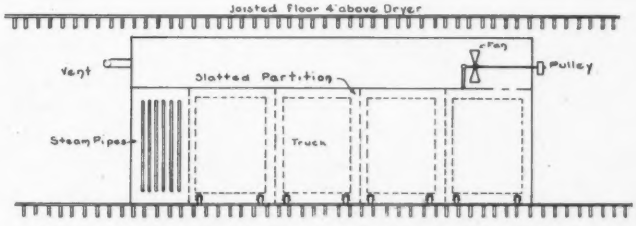
The air set in motion by the fans passes through steam pipes, which warm it, and on downward to lower section circulating through trays of tobacco on the trucks to other side then upward and back to fans, making a complete cycle.

Temperature of drying air in these rooms is about 150-160° F., which is much lower than it is in drying machines and the drying period is, inversely, longer.

The rooms in which the tobacco is "ordered" after being withdrawn from the dry rooms and cooled are just the same in all respects as the dry rooms, except that the steam pipes are removed and the fans circulate, instead of dry heated air, the humidifying vapor of steam.

An exterior and interior view of one of these rooms is shown on page 36, October, 1907, issue of the Quarterly.

There are other forms of these dry rooms variously modified, some wider than long, some with steam pipes below fans—directly underneath or on opposite side of enclosures—but in all major respects they are similar in arrangement and operation to the type described.



Another form of Truck Dry Room (Interior Circulation).

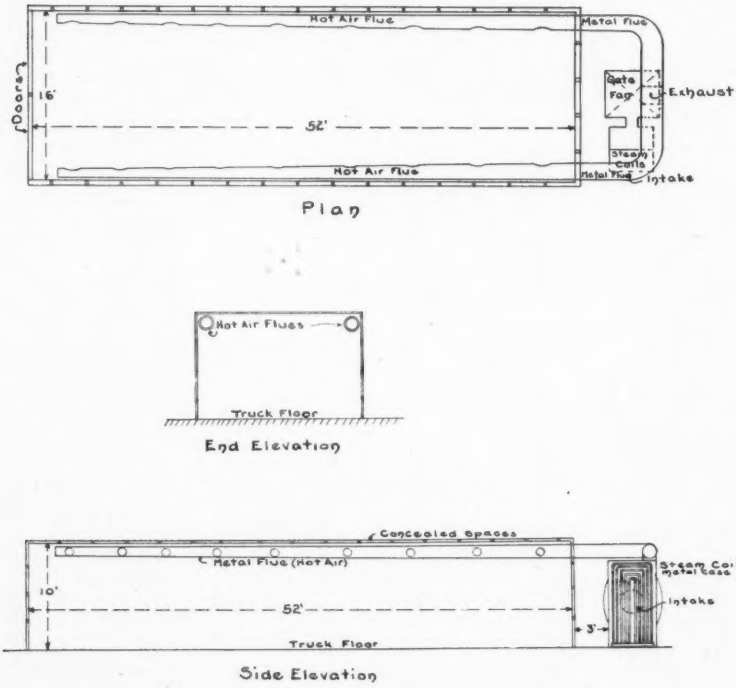
Steam radiator at side. Room wider than long; only three fans in these rooms.

These rooms are built both by the tobacco machinery manufacturers and by the manufacturers of tobacco themselves, the latter home-made. The Philadelphia Textile Machinery Company and The Philadelphia

Drying Machinery Company build them and when they do the rooms are given trade names, "Cyclone" and "Hurricane," respectively. There is another special form of same type known as the "Carter System."

The room previously described in detail is built and used by a large tobacco corporation and does not bear any distinguishing name as near as the writer can ascertain.

Exterior Circulation Truck Dry Rooms, otherwise termed Hot Blast, Forced Draught, etc., are merely oblong enclosures also rectangular in cross section, into which extend perforated flues from outside fan and steam coils. These flues are of metal and extend throughout length of rooms overhead, one each side; the perforations are large, nearly the diameter of the flues and are spaced about six feet o. c. A



Truck Dry Room. (Exterior Circulation.)

large fan at each room draws air through a steam radiator, forces it into flues and on into room. The fan and steam coils may or may not be close to dry room, sometimes they are removed quite a distance.

Miscellaneous Truck Dry Rooms.—There are still in use, though but few, dry rooms in which there are no fans and where the air is heated by steam pipes at sides, and in a case or two, on the floor under

the trucks, as in the Lumber Dry Kiln. The temperature in these rooms is often quite high. These rooms are sometimes termed "Old Style" Dry Rooms. They are.

SPECIAL FORM DRYING MACHINES.

Under this heading can be classed the **Rotary** and **Reel Dryers** of John B. Adt of Baltimore. The former is termed the "Perfection" Dryer and is illustrated and described on page 41 of the October issue of the Quarterly. The latter, known as the Plug-Cut Dryer, is illustrated and described on pages 50 and 51, aforesaid issue.

There is a modification of the Reel Dryer in some older tobacco factories, modified as regards heating, fire-heated flues being used instead of steam pipes. (See Special Hazards.)

Various kinds of small low temperature dryers abound in tobacco factories, variously used for plug wrapper and label drying, etc. They are not of enough consequence to warrant description here.

Snuff Dryers or Toasters are in a class by themselves. The Adt New Improved Furnace Dryer is prominent among these and is illustrated and described on page 53, October issue.

Another arrangement observed by the writer consisted of a number of metal pans superposed and enclosed in a brick room, narrow and high. The room was heated by steam coils at bottom. Snuff to be dried was dropped onto top pan and shaken from it to the pan below by a slow oscillating movement and so on down to the bottom tray and out.

HAZARDS OF FIRE IN TOBACCO DRYING APPARATUS.

The introduction of patent drying apparatus began about eleven years ago. At that time most tobacco was being dried by inert air in enclosed spaces or rooms highly heated by steam.

Attending this method of drying were many conditions which were little short of deplorable as regards proper prevention against fire.

Notice of this was recorded in a letter written to the Engineering News, October 27, 1908, by an official of a well-known insurance company and reprinted in Insurance Engineering issue of July, 1903, as follows:

THE ADVANTAGES OF FORCED BLAST HEATING SYSTEMS FOR DRYING KILNS.

Sir: One of our special inspectors has written to us, after a very thorough examination of premises in the South used for drying and ordering tobacco, recommending the introduction of drying kilns of the blower type as a substitute for the present method of drying by direct steam pipes. He states that manufacturers report that when once installed the process of drying by an air blast is preferable to and quicker than the steam pipe method, and he dwells particularly on the fact that in the elimination of the steam pipes from the rooms a great source of fire hazard is removed, as his inspection indicates that in no class of risks where dry rooms are used is there more universal carelessness than is found in the tobacco business. In addition to

the improvement in methods, which is suggested, anything which tends materially to reduce the hazard from fire will unquestionably influence the rate which will be charged for insurance, and we write you suggesting that you call the attention of manufacturers of machinery and apparatus answering this description to the field for sales which seems to be clearly pointed out by our inspector.

You, of course, understand that we can only refer to the subject in a very general way, as the advantages of a change in system, or the reduction in the insurance rate which the change might warrant, would be determined by the conditions found in each separate property.

Yours truly,

E. L. BALLARD,
Assistant Secretary Continental Ins. Co.

46 Cedar St., New York City, Oct. 27, 1898.

[We believe that the general advantages of the blower system for drying kilns over the old method of drying by steam pipes directly in the kiln are now conceded by all who have given careful study of the matter. The reduction in fire hazard by this system, however, is a point which is, perhaps, not so generally understood, and the above letter is useful in calling attention to it. We may say in addition that the excess in first cost of the blower system over the old direct steam-pipe system is not so great as is sometimes claimed. With the blower system the steam pipes are so much more efficient that a considerably smaller number of square feet of heating surface is required for a given work than is required with the direct steam system.—Ed.]

In interesting contrast to this view of the matter is that of another underwriter which appeared in Insurance Engineering, Vol. 3, Page 180, February, 1902, as follows:

A prominent underwriter who has been closely identified with the matter of tobacco losses in the vicinity of Richmond has this to say on the subject of the dryer hazard: *"With the introduction of artificial dryers I believe we have a hazard in tobacco factories and warehouses fully equal to that of the average lumber dry-kiln.* No rate that we can name will ever pay for some of the most dangerous of these equipments and this underwriters will later on realize. Another feature is the incapacity of the fire departments in any of the towns in the South to stop a fire once started in the tall heavily loaded buildings where tobacco is handled. Our special agents are just beginning to understand this, and we now have some hopes of keeping our lines down. What companies need to do is to watch the new hazard known as the patent dryer. *It means a loss in nearly every case,* unless proper safeguards, such as sprinklers and steam jets are insisted upon. *There is no such thing as air drying these days in the modern factory."*

One commends and the other condemns, which is of course not unusual especially where the question of a hazard is concerned.

The introduction of the patent dryer was a step in the right direction but the special inspector referred to in the letter did not, nor did any one else, realize what other hazards would be introduced in eliminating the one mentioned.

The evolution of the drying machine or any machine or manufacturing process has to progress through a period of experimentation which

is fraught with difficulties. The difficulties as met with have to be overcome.

The extreme view of the hazard as above quoted was occasioned by the early experience had with the machine. In view of results to date such sentiment as "with the introduction of artificial dryers I believe we have a hazard * * * fully equal to that of the average lumber dry kiln" appears rather an extreme prophecy. Also does "It means a loss in nearly every case." And if "There is no such thing as air drying these days in the modern factory" indicated a preference for the conditions of past years such would be opposed to the contention of others also competent to pass on such matters.

Another prominent Southern underwriter commenting upon the strained conditions of tobacco risk insurance where dryers were involved in the early part of 1902, stated that many companies were declining such risks believing that it was only a question of time when a loss would occur. *Notwithstanding the use of steam jets and automatic sprinklers.*

Such speculation was rife in those early days but today rates on tobacco risks are not loaded with a charge for patent drying apparatus where such are installed and equipped with fire protection in a proper manner.

The foregoing is given as a contrast of the views of an engineer who commended and of underwriters who condemned the introduction of improvements in tobacco drying. The opposition was sincere enough and justified by facts and figures—but for a time only—while experience has justified the contention of the insurance engineer. Drying by circulated air is in every way preferable to drying in inert air. Today it is an exact science and quickly accomplished. No more hanging of large quantities of this valuable product highly susceptible to damage.

It may be safely and conservatively asserted that there is nothing specially hazardous in drying tobacco as far as the material to be dried or the means of drying are concerned. The great trouble has been and is in the introduction of foreign material into the dryers and that foreign material is **Matches**. This of course is assumed from experiences of others. Fires occur from causes not always definitely ascertainable after the fire but the consensus of opinion points to matches as the chief cause.

Often it has been taken for granted that a hot bearing was the cause when other reasons failed, but few if any such theories were conclusive beyond considerable doubt. Now as a matter of fact this has not been so much so with the match proposition. Quite often it has been quite definitely established that matches caused the fire. Only recently, February, 1908, a fire occurred in a drying machine in a Plug Factory in Richmond, Va., in which "dipped filler" was being conditioned. Those in charge are quite positive that it occurred from matches. Fires in "dipped filler" dryers are very rare if any nowadays and one caused by matches is the first one recorded to the writer's knowledge in several years. "Dipped filler" handled so many times as it has been before it reaches the final drying is generally assumed to be free from all foreign material though it is possible, as in the case above cited, for a box of matches to be accidentally, if not with

intent, dropped into the leaf before it gets into the "dipped filler" dryer.

This case adds much weight to the "Matches" theory—if it needs it. It may be well to state at this point that the fire was extinguished within the dryer with but small loss and no claim was made.

The theory of "spontaneous combustion" in tobacco dryers may be set aside as being rather untenable.

The Matches Hazard.

The possibility of a fire being caused by matches varies considerably, according to the nature of the tobacco to be dried and the method of doing it. Leaf tobacco dried on sticks hung in a special stick machine is immune. Leaf tobacco stemmed or not, dried on aprons, is also quite so, as the bundles of leaf are each shaken out before being laid on the apron, although there is a remote possibility that matches might be maliciously put on the apron, whereas such a thing could not well be done in a stick machine. Akin to this is the so-called "dipped filler" tobacco dried in plug factories. This particular kind of tobacco has long been supposed to be immune to fires in dryer enclosures and it is practically, but the above recorded fire illustrates a possibility. This tobacco before it enters the dipped filler dryer has been previously conditioned, handled and stemmed, so there is nothing in the nature of it that can be said to be hazardous in the least.

In drying **Scrap Tobacco** there is an ever present positive hazard. The presence of matches in it is to be expected. Scrap tobacco comprises the sweepings and trash of Sales Warehouses, Prizeries and Factories and in it, besides matches, are food refuse, rags, paper, and what not. Tobacco men claim to condemn the practice of drying scrap tobacco in patent machines, but it is generally done just the same.

A prominent manufacturer of tobacco drying machinery states: "We are of the opinion that most fires have been caused by matches which have passed in the machine with scrap tobacco. There is scarcely a fire that has occurred in the drying machine that has not taken place when they were drying scrap; in other words, we do not know of a single fire that has taken place when leaf tobacco was being dried on the sticks, but so far as we know all the fires have occurred when scrap was being dried on aprons. We have arrived at this conclusion after having talked with the owners of the dryers that have caught on fire. In 100 stick and apron machines we only know of fire having occurred in one."

Another manufacturer of drying machinery said: "We have about 60 machines in use, only two have burned and they were working scrap tobacco."

The following is especially of interest coming as it does from one who has had a considerable experience with tobacco dryer fires in interest of certain large tobacco manufacturers: "As yet we have never had a fire in a stick machine, but they do occur occasionally in machines of the apron type. Our theory is that matches must get in the tobacco in the Sales Warehouses and when the tobacco is placed

on the apron a match can easily stick through the wire mesh head downward and light as it passes over the rollers (supporting apron); this difficulty is found generally when scrap tobacco is being dried, although we have heard of it occurring in the handling of the better grades of leaf."

A prominent special agent in Virginia several years ago devoted some time to investigating this subject and his conclusions were as here quoted: "I have spent quite a little time making inquiry among the tobacco men as well as insurance men and I can only find one instance where a fire originated in a patent drying machine, when same was being used for other than drying scrap."

The sentiments of three vitally interested parties agree. Insurance Engineers have verified these theories by conducting tests to determine ignition points of various matches. These tests were conducted by the Committee on Matches, National Fire Protection Association, and reported to the Association at the 1907 meeting. The results of these tests are as follows:

	Parlor.	Sulphur.	Double Dipped.	Domestic Safety.	Foreign Safety.
Min.	195° F.	175° F.	261° F.	257° F.	254° F.
Max.	270° F.	175° F.	263° F.	365° F.	370° F.

It will be readily seen from this table that the sulphur match would be readily ignited in most any dryer enclosure, and also, but not so readily, the parlor match. The higher degree matches might pass through without igniting but these types of matches are not so largely used as are the others.

Similar in point of hazard from matches is the **drying of tobacco stems**. This is practically a special branch of the tobacco industry, as the stems from the various Stemmeries are handled at some central point, and not common as is drying scrap and trash. Stems burn much more readily than the leaf, as they contain potassium nitrate, and a fire in a stem dryer is apt to be quite a hot one.

Of 63 owners of tobacco drying machines interviewed by underwriters' inspectors only 12 had had experience with fires in them and seven claimed that the fires they had known of occurred when scrap tobacco was being dried.

So much for the nature of the material to be dried and the hazards thereof. Let us now consider the hazards of the means of drying it, the Patent Drying Machine.

Drying Machine Hazards.

The various features will be considered in the same order as the machine was described in chapter on Tobacco Drying and Drying Apparatus.

Steam Pipes. Necessity for keeping these pipes clear of woodwork and free of tobacco dust is understood without comment. Properly installed and clear and screened against tobacco being blown over on them from apron when fans draw or blow up as in the Proctor Machine, they are innocuous as a source of hazard. They are more easily cared for when arranged at the sides of machines. Steam pipes be-

tween fans and aprons are not desirable. Cases have been observed where they have become caked with oil and tobacco dust below fan bearings.

In the multi or superposed apron dryers of the Proctor make it was observed that considerable tobacco was lodged in the steam radiators at the sides of the machines. This is because the apron or conveyor section is not properly screened and the blast from the fans carries over some of the leaf. The machinery makers state that this deficiency will be corrected in new machines.

Fans. Fan blades nowadays are generally of steel. A case is recorded where a loose steel fan struck the steel beams supporting its bearing, thereby making sparks and causing fire. However, this is an unusual case and not indicative that this is a hazard worth considering.

Fan Bearings. This subject was covered quite extensively in the chapter on Tobacco Drying and Drying Apparatus. Horizontal fan bearings having the self-aligning ball bearing feature, as in the Proctor Dryer can be considered as being, if at all, very mildly hazardous. Ball bearings not self-aligning are apt to run hot and plain thrust bearings are unsafe.

It is desirable that these bearings be outside of the dryer enclosure where they will not have to run in a heated atmosphere, and where they can be readily observed. However, these fans run at a slow speed, 100 revolutions per minute or so, and the experience that has been had with the self-aligning ball bearing certainly justifies the manufacturers of certain tobacco drying machinery in maintaining that it is not necessary to have such bearings without the dryer enclosure to insure safety.

Such bearings properly lubricated at the beginning of the day's run will run cool without doubt.

Bearing troubles with horizontal fans are exceptional nowadays. The old machines in which such troubles were experienced have either been abandoned and replaced by newer dryers or altered and improved.

The bearings of the line shafting which drives the horizontal are apt to heat up if not properly cared for, but they are self-aligning and given moderate care should never give trouble.

The vertical fan bearings is another matter. Such bearings should be outside of the dryer enclosure unquestionably. Vertical fans run quite fast and the bearings are of the ordinary babbited journal variety, some improved by ring-oiling arrangements. Notwithstanding all that can be said against such bearings inside dryers, fires caused by them have been very infrequent.

The experience of tobacco manufacturers with fires supposed to have been from heated bearing causes dates back several years.

With average care and proper maintenance the operation of a drying machine should not be more hazardous than the operation of any other special mechanical apparatus. In well regulated factories the bearings are properly lubricated before the day's run and at the finish of the run the entire machine is cleaned out, especially the bearings.

In concluding the subject of bearings it is pertinent to quote what is said by a certain tobacco machinery manufacturer, as follows:

"Among the first installations made with large horizontal fans a great deal of trouble was experienced in securing a proper bearing for

the fans, one which would stand without heating. **During the past five years since improvements were made we have not heard of a single instance where bearings have given any trouble."**

Conveyor Apparatus in a drying machine cannot well be considered a hazard, but it might be well to record a theory held by one or two tobacco men for what it may be worth. The theory is that a nail passing in an apron dryer with the tobacco might become imbedded in the wooden rolls supporting the apron (this does occur numbers of times) and strike a spark when coming in contact with the apron as the roll revolves. The apron moves very slowly as do the rolls so such a hazard is admittedly a very remote one.

In the multi or superposed apron dryer where the drying section is laterally divided the horizontal partition effecting the division is located just beneath the top of the middle apron about three inches or so. In time this partition becomes loaded with highly dried scrap which drops from above and clogs the rolls so that they cannot move. While this is not an acute hazard it is a very undesirable condition. The writer brought this to the dryer manufacturers and they state that this partition will be left out of new machines.

Exterior circulation machines of the Conveyor Class, such as the Moseley & Goodwyn, have the advantage in point of hazard over those dryers of the Interior Circulation variety, in that there are no moving parts within the dryer enclosure except the apron rollers and one bearing of the cooling fan. However, and counteracting this advantage, there is a possibility of dust and foreign material being blown into the dryer as the intake of the steam coils is inside the building.

In Truck Dry Rooms of the modern type (Interior Circulation), hazards of fire are very remote, if at all. These rooms are used for high grade tobacco and the temperature in them is moderate. The steam coils are located overhead above a board partition; likewise the fans. There is a possibility that there might be a heated fan bearing as the fans revolve somewhat speedily, but such is very remote if the bearings are reasonably well cared for and if a bearing did become overheated the chances of it doing damage are almost nil.

Truck Dry Rooms of the exterior circulation variety have an advantage in that all moving parts are outside but cannot be considered as being such a great deal better than the former type.

Drying by inert air in highly heated rooms, so-called old style, is rarely but yet sometimes used. The steam pipes should be kept clear of woodwork and tobacco and such rooms should be kept scrupulously clean. Such drying is not desirable in point of hazard.

Of the special forms of dryers the Adt Rotary or Perfection Dryer is the most largely used. An illustration of this is on page 41, October, 1907, issue of the "Quarterly."

In this machine the tobacco comes directly in contact with the steam pipes which are fixed to the inner side of the dryer shell and act as paddles to tumble the tobacco about. The tobacco is constantly in motion and does not continue long in contact with the pipes. This has been considered hazardous by some but it is not. No fires have ever been recorded as having been caused by this condition or any other in the Adt dryer of this type. In drying some grades and kinds of tobacco in this machine considerable dust arises which of course should

be properly taken care of. Possibly the most hazardous use this dryer could be put to is in drying crushed stems, as in cigarette factories. Stems in this form burn very readily but nothing has ever occurred which would make the hazard seem any more real than it is apparent. In short, these dryers when heated by steam can be considered as ordinarily hazardous.

There is one thing about them though that is undesirable. It is the practice to cover the shell with **hair felt** to minimize wasteful radiation of heat. Incombustible covering should be used for this purpose the same as on steam pipes.

The reel dryer as illustrated on page 51, October, 1907, issue, can be considered as being only ordinarily hazardous. The steam coils at bottom are screened to prevent falling material from getting on pipes and easy access is had for cleaning purposes. These dryers are generally used for plug tobacco or other finished material so the chances of uncleanliness are remote.

Reel dryers are sometimes, as in some old plug factories, heated by a coal fire in a manner quite similar to that illustrated on page 17, October, 1907, issue of the "Quarterly."

In several factories in Petersburg, Va., which were visited, the dryer was located in a brick room adjoining and communicating with factory building. The furnace was below the reel and fired from the outside. The top of the brick fire box was covered with iron plates which radiated the heat and also radiation was had from the flue which passed over the floor to a brick chimney built in the wall. The conditions of this arrangement as observed were only moderately hazardous. The fire was well confined and the flue securely arranged. Unless this is so, such a source of heat might prove dangerous. Nevertheless this form of drying should be cut off from main building.

Snuff Dryers and Toasters are heated with steam and direct fires. In them snuff is dried to a point bordering upon carbonization. Such operations are preferably carried on in separate buildings cut off.

The chances of fire in drying machines vary more with the kind of tobacco which may contain more or less foreign material than with the character of the machine itself. Most fires have occurred in the Interior Circulation type of the Conveyor Class, but that is no criterion that they are to continue from causes in the machines themselves. Fires when drying scrap are expected, do occur and are extinguished invariably with small or without loss. For a long time "dipped filler" dryers have been considered as immune to fires.

The case hereinbefore cited disproves this assumption. In any apron machine, no matter what it dries, there is ever the possibility that matches may be introduced into the machine, carelessly or maliciously.

FIRE PROTECTION OF DRYING MACHINES.

The prevailing standards for fire protection in dryers, of underwriters having jurisdiction in those sections where patent dryers chiefly abound, contemplate both automatic sprinklers and manually operated steam jets.

Certain large tobacco manufacturers add to these devices outside hand hose.

Various efforts of misdirected mechanical genius have been applied to the introduction of various automatic devices in dryers which aimed at the automatic opening of steam jets in case of fire by the parting of fusible links releasing a weight holding the valve closed; also the automatic shifting of a belt to shut down the fans; also to blow a whistle, etc.

The operation of automatic devices in drying machines is always indeterminate and inversely efficient and positive in operation as the releasing temperature of the device increases.

It is even so with automatic sprinklers to a degree—286° heads are generally used and heads of this temperature operate tardily. Oftentimes the intelligent use of a small stream of water on a fire within a dryer where convenient means of ingress are provided will extinguish it before the sprinklers open. Then again the motion of the fans where beating down will retard the operation considerably, keeping the heat from the fire away from the sprinklers.

All sorts of schemes have been used in dryers for fire protection. The perforated steam pipe overhead was probably the first; this was limited to the drying section only. This was found lacking so it was changed and located below the apron. Then came the perforated water pipe overhead. Automatic steam jets have been tried. Also automatic valves opening perforated pipe lines and so on.

Steam Jets. Various conflicting opinions obtain regarding the efficiency of steam jets in controlling a fire. This subject was extensively covered by a Committee on Investigation of the Value of the Steam Jet as an Extinguishing Agent, Mr. F. J. McFadden, Chairman, which reported to the National Fire Protection Association, at the 1905 meeting. The reader is referred to this report which is a highly able exposition of steam jet protection.

Certain excerpts from this report have a bearing on the subject matter of this paper and I quote them: "We find that proper 'Steam Jet' protection cannot be afforded rooms or enclosures of large or moderate area, provided with large ventilators or outlets that would permit the larger part of steam to escape from room or enclosure."

Yet steam jet lines are demanded by underwriters throughout dryers and the steam cannot be confined in the cooling section of a dryer. Certain fires have been observed where the steam was wasted in the cooling section and did not have any effect on the fire. The effect of steam on a fire is from the occlusion of air from the fire by it, as air except under pressure above an atmosphere will not mix with steam; consequently in the cooling section the steam is wasted as it cannot be confined. In the writer's estimation steam jet lines need not extend beyond the drying section. Most fires occur in the drying section of the machines and in the first compartment.

Again I quote from aforesaid report: "We direct attention to the necessity of properly arranging the 'Steam Jet'; and also the error of recommending this form of protection when a proper volume of steam under good pressure, is not available." This is most important but how often is it figured out?

The necessity of installing steam jets in dryers where automatic sprinklers are provided can be reasonably questioned. An interesting side light on this is advanced by a person whose opinion is entitled to

profound consideration in this matter, as follows: "One fire that did reach such proportions that the heads were operating nicely and had the fire under control was made very much more serious from a loss standpoint by turning on the live steam, with the result that every head in the machine, some 90 in all, were fused with the resultant water loss on all the tobacco on the belt. It developed after investigating the fire damage that the burning woodwork was well within the limits of the heads that were operating before the steam was turned on." As the value of tobacco on an apron runs as high as 57 cents per square foot in some cases it is easy to imagine what would have been the difference if the steam jet had not been used.

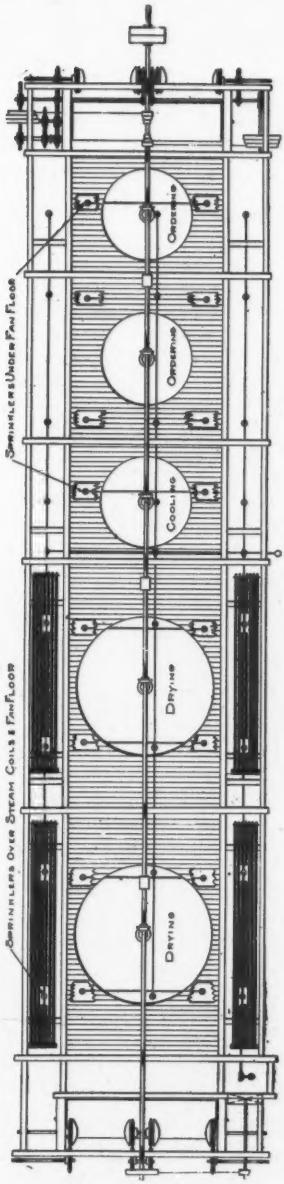
Present standards of underwriters governing installations of steam jets require a three-quarter inch orifice "looking down" about 6 to 12 inches above the floor in each compartment supplied by a two-inch pipe controlled by a quick opening lever valve outside of dryer. There are some long machines where such a size pipe would be inadequate especially where the steam is wasted in the cooling section. Three hundred and fifty **square feet** is established as the maximum allotment for one jet, but extra size supply pipe is overlooked. It would seem that a certain maximum cubage had better be established.

Automatic Sprinklers. The desirability of equipping all dryers with automatic sprinklers cannot be questioned. The following sentiment comes from a source where considerable experience has been had with fire protection in tobacco dryers. It is as follows: "As yet we have never lost a machine which we considered properly sprinklered."

Sprinklers in dryers should be installed throughout, above and below fan deck in such machinery as have horizontal fans, at top of side spaces and in all ventilating flues. Heads should be spaced with regard to freedom from obstruction by construction members of dryer enclosures and "staggered" on alternate lines; the National Standard scale of piping should be used. The area per head should be small as practicable, not over 64 square feet and may be upright or pendant; upright is best and on account of limited head room the deflectors can be as close as one inch to top and give good results. In horizontal fan machines heads above fan deck should be so arranged that they are not directly over those below fan deck. Spacing of heads on branch lines should not exceed eight feet and lines should not be over four feet from any wall or partition in the dryer. Pipes should be properly pitched to drain and sprinklers should be controlled by a valve outside the dryer enclosure.

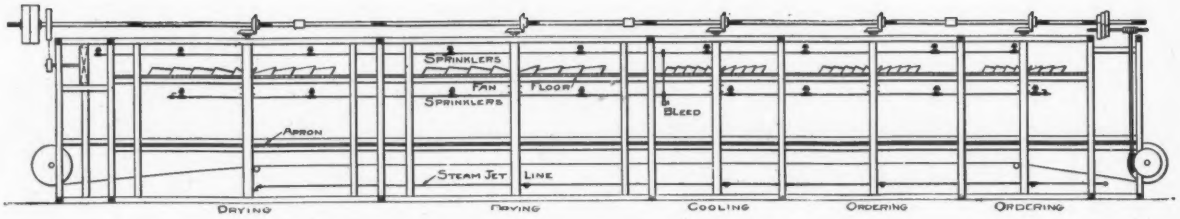
In old machines sprinklers were installed without any regard for proper arrangement of heads. Pipe lengths of eight feet were cut and the line made up and "stuck" in the dryer. It did not matter where the heads came. In the ventilating flues of the cooling section the heads were not raised any higher than the others and consequently the entire excess height of these flues are without protection in many cases.

I quote the assertion of a competent engineer on this point: "One of the principal defects in the sprinkling of these machines appears to be in the way the ventilating ducts at the cooling section are sprinklered, the heads here being at the same level as those through the machine, so that if a fire gets out of the machine proper into this duct and beyond the line of sprinklers no water can reach it. We have extended the



Plan Showing Arrangement of Sprinklers in a Proctor Dryer.

By courtesy of the Philadelphia Textile Machinery Co., Philadelphia, Pa. Manufacturers of "Proctor System" Tobacco Drying Machinery.



Longitudinal Section Showing Arrangement of Sprinklers in a Proctor Dryer.

By courtesy of the Philadelphia Textile Machinery Co., Philadelphia, Pa.
Manufacturers of "Proctor System" Tobacco Drying Machinery.

sprinklers higher up so they will protect this duct throughout its length." This should be done in all cases.

Two water supplies for dryer sprinklers are required by underwriters having jurisdiction, same as are required elsewhere. Gravity tank and a waterworks connection are the supplies generally in use. An ideal combination would be a pressure tank and waterworks connection. Initial heavy pressure is desirable and when a pressure tank is not used the primary pressure should not be less than 25 pounds where possible.

The following sentiment from a large tobacco concern is of pertinent interest: "From our experience we feel that the danger from drying machines when properly sprinklered is very much overestimated."

A mistake is made in installing high degree heads (286°) throughout dryers. Two hundred and twelve degree heads are sufficiently high outside of drying section proper in cooling and ordering sections where the temperature is much lower.

Hand Hose Protection. The use of a small diameter linen hand hose has been found by experience to be very efficient in handling dryer fires. As bearing on this form of protection I again quote from the above-mentioned source. "In addition to the sprinklers and steam jets we are installing in some of our plants small hose lines at frequent intervals alongside of machine to make it possible to stick a nozzle in the machine readily. As you know it takes quite a fire to actuate a 286° sprinkler head so that the majority of fires are put out before the sprinkler heads show any signs of opening."

To make this form of protection efficient ready access has to be had to interior of machine. This is not possible in older machines and this question of accessibility will be considered further on.

In summing up this question of fire protection it is well to consider the views of those who have had the most intimate experience with dryer fires. The present day standards for fire protection are but little improved over what they were when the question was a new one some years ago. When fires are repeatedly extinguished with small hand hose without loss it would seem that this protection would be worth recommending as being superior to steam jets, always considering of course that automatic sprinklers are provided as they are indispensable in covering a retreat as it were.

Such hand hose to be of not more than one and one-half inches in diameter; to be of approved linen in lengths of not over 25 feet with brass play pipes with five-eighths of an inch smooth orifice kept attached and racked ready for quick service. Controlling valve to be at each hose connection and pipe supplying same should not be less than two inches.

The fact should not be lost sight of that ready accessibility to the interior of the dryer is indispensable to the efficient application of this method of protection. The human agency is the factor depended upon to discover fires in drying machines and every convenience should be afforded in the arrangement of the dryer to favor this as in most all cases fires occur when the machine is in operation. And the very first thing to do when a fire is discovered is to shut down the machine.

ARRANGEMENT AND LOCATION OF CONVEYOR DRYING MACHINES.

This subdivision of the general subject of dryers is most important **Accessibility** to the interior of the dryer enclosure should be first considered. As bearing on this I quote from a reliable authority: "Most of the fires brought to my attention seem to occur in the drying sections, and in order that the hands feeding the machine can readily detect a fire we have a couple of thin glass windows put in the charging end so the tobacco can be seen as it travels along. In this way fires can be seen before they burn a place a foot square, and are easily extinguished."

The matter of ready accessibility has not been given the consideration that it should be by tobacco dryer manufacturers. Some machines are very difficult of access. Every possible means of access should be provided to all parts of the interior of a drying machine, such means as will be **quickly available.** The insertion of windows in the walls of a drying machine is a most excellent thing.

Cooling Section Flues. The heated air driven off from the tobacco in the cooling section is, in most modern machines, carried off through wooden flues to the outer air. In these machines the top of the cooling section is open and the air is drawn down by the fan, forced through the leaf on the apron and out through the flues. In some old machines the air was forced up through the tobacco into the room depending upon ventilation in the roof to dissipate the exhausted air.

As illustrating the undesirability of the absence of flues at the cooling section a reference to the Spicer fire in Richmond, Va., November 30, 1903, is apropos. This fire was undoubtedly spread considerably by the cooling fan as the machine was not shut down quickly. The top was all open and steam from the jets was quickly dissipated.

Flues should be provided in all cases to convey away the wasted air and they should be of metal. These flues should in all cases pass directly from the dryer to the outer air and should not pass through floors or attics. There might have been another story to tell at South Boston, Va., in early 1907 had these flues been properly arranged. As will be remembered there was a general conflagration there. The fire started in a tobacco dryer. The flues from the cooling section were of wood and passed through a blind attic to the roof. Soon after the fire was thought extinguished in the dryer it broke out in this attic and soon involved the entire roof and next the main building adjoining. The fire department were unequal to the task of controlling it and South Boston was considerably burned.

The following is the opinion of reliable authority: "One reason why a fire can travel through these flues so readily is because there is a fluffy fibre given off Virginia and Carolina tobacco which lines the flues, and being very easily ignited is apt to spread a fire rapidly. We are overcoming the possibility of a fire getting beyond us in this manner by making the flues of metal and sweeping them at frequent intervals. Another weak arrangement is to have the machine on a

lower floor of a plant and running these flues through a blind attic or the floor or floors above to the roof, thus allowing a fire to get at an inaccessible point." That fits the South Boston blaze.

Location of Machine. It is recognized as the best practice to locate a drying machine in a one-story building especially erected for the purpose. This is more particularly the case in Prizeries and Stemmeries where the dryers are often very large. Certain dryers, however, of necessity have to be located in the factory buildings of some factories, such as "dipped filler" dryers in plug tobacco factories. These dryers are of moderate size generally. Certain advantages are obtained by locating them in the top story. If so located they should be set in drain pans adequately drained outside of building so that in case a fire has to be fought the water will be carried off without doing damage on the floors below. If located on ground floor such a drainage arrangement may not be necessary but the flues from the cooling section should by no means be run up through the floors above. They should pass out in the same story the dryer is in.

Some manufacturers paint their machines inside with "fireproof" paint. A negro was assigned this task in a southern manufactory. He went inside with a can of Paroid Paint and a lantern. He came out soon and quick. The fire department extinguished the blaze. Would that negro need be told about volatile thinners in paints now?

MISCELLANEOUS CONSIDERATIONS REGARDING DRYERS.

Maintenance. The proper care and maintenance of a machine of this kind is most important. In well regulated manufactories the machines are carefully oiled up before a run and cleaned out after it. Moving parts are frequently examined and repairs made if necessary. Especially should the cooling flues be cleaned out.

Capacity of Drying Machines. Machines of the Proctor type have a drying capacity of 6,000 pounds per hour in 12-foot stick machines and about 2,500 pounds per hour in 12-foot apron machines. Per unit of area this would be about 1.33 pounds per square foot in apron machines and three pounds in stick machines.

Total value of tobacco in a dryer varies considerably with the grade of the leaf, ranging as high as $700 in long stick machines, as low as $80 in shorter ones and in apron machines from $10 to $600. Values per unit of area vary between 5 and 57 cents.

A dipped filler dryer 117 feet long with a 12-foot apron would have an apron area of 1,404 square feet approximately. With 500 pounds on the apron at 25 cents a pound (which includes cost, leaf, prizing, stemming, casing, etc.) the total value would be $125; pounds per square foot 3.5 approximately, value 8.8 cents approximately.

Operation of Machines. The practice of drying scrap by itself is admittedly a bad one but to dry scrap on the apron of a combination machine when tobacco is being dried on sticks is reprehensible. It should never be done.

Many manufacturers and handlers of tobacco leave the leaf in the apron at the end of a day's run. This is poor practice. The leaf should be run out of the machine. The chances of fire smouldering in

the tobacco and breaking out after the machine is left for the night are possible.

The period of active operation of dryers begins about September or latter part of August and continues until May of the succeeding year.

Some Suggestions for Improving Dryers.

Drying machines to be located in a separate building especially adapted. Where not possible to do so, machines should be set in drain pans throughout entire length properly arranged.

Drying section of enclosure to be of steel frame panelled with incombustible material.

Frequent means of view and ready access to interior of machines should be provided.

Flues from cooling section to be of metal and to pass directly out of building therefrom and not through floors or ceilings.

Conveyor section where fans blow or draw up should be screened to prevent tobacco being blown in pipes.

SPECIAL HAZARDS OF THE TOBACCO INDUSTRY.

It may be well in discussing the question of hazards to first consider the inherent hazard, so to speak, in the tobacco leaf itself. The exact nature of the phenomena of which this hazard is resultant is briefly described on page 22, October issue of "The Quarterly" in connection with the theory of fermentation of cigar leaf tobacco. Knowledge of this is consequent on investigations made by Dr. Oscar Loew, formerly of the Division of Vegetable Physiology and Pathology, United States Department of Agriculture.

The phenomena is one of the many forms of oxidation which is the broad physical principle underlying all of the various manifestations of spontaneous heating. This may or may not cause fire in the material itself when so heated to a considerable degree but when such material is in contact with a combustible substance, as for example, wood, this heating may carbonize it to such a degree that visible combustion results.

This oxidation or fermentation obtains in most all types of tobacco leaf but in widely varying degrees. In some, such action would not be sufficient to generate a hazard. Even at its worst the hazard is more a theoretical than a practical one as such action allowed to continue would destroy the value of the leaf if nothing else and all along the line from the barn to the factory the condition of the leaf is closely watched. There are cases, though isolated, where this action has actually occurred to a dangerous degree.

Some tobacco handlers claim that if the leaf is imperfectly dried and bulked in too high "case" or "order" spontaneous heating is likely to result. Others aver that the drying has nothing to do with it but that heating results from too much "order" alone. One case is recorded where a hogshead of bright tobacco, after being in a warehouse for several years, was opened and found to be a badly charred mass shrunken several inches away from inner sides of hogshead. Another

where a heap of floor-dried scrap when turned over was seen to be smoking. This scrap was in what is known as "farmers' order" and was swept up from the floors of Sales Warehouses.

"Dipped filler" in bulk is generally supposed to be free from this possibility as the leaf is so carefully conditioned. However a case is recorded where spontaneous heating occurred in a "bulk" of "dipped filler." The watchman making his rounds through the factory where this occurred noticed a small hole slowly burning in the ceiling. He investigated on the floor above but could see nothing. About over the hole as near as he could reckon, was a "bulk" of "dipped filler." The fire department responded to his call and upon tearing down the bulk a charred mass about the size of a barrel was found in the center of it. This was so hot that the hand could not be held in contact with it.

The types of leaf in which oxidation is probably most intense are the Florida Cigar types. In others the action may be more moderate. All persons familiar with the handling of tobacco are cognizant of this condition and where the "order" is thought to be too high the "bulk" or pile is frequently torn down to avoid heating which would mean pecuniary loss. The following excerpt from Report No. 60, "Temperature Changes in Fermenting Piles of Cigar Leaf Tobacco" by Whitney and Means, United States Department of Agriculture, 1899, is of interest: "Our investigations showed that the Florida leaf to be in good 'case' for starting the fermentation, should contain from 23 to 24% of water. Several piles were examined where the water content was about 20% and in almost every case it was found that tobacco having no more moisture than this was too dry to ferment and even too dry to handle safely. On the other hand when the tobacco has 26% of water it is too wet and is liable to rot in the fermenting pile." These contentions apply strictly to the Florida leaf. Other types cannot be similarly considered. Coarser leaf can be handled with less "order" obtaining.

As before-stated the proper burning of tobacco is influenced by the potassium salts and cellulose content. Tobacco stems are rich in the salts, more so than the leaf, principally in the form of potassium nitrate which causes the stems to burn more readily than the leaf and to hold a low fire for a long time where a free supply of oxygen is not had. A fire occurred in a Rochester, N. Y., manufactory several years ago in a pile of dried tobacco stems; it smoldered and after a time burned a hole in the floor. The fire was discovered before it burst into a blaze and was extinguished with small loss.

Before proceeding further with the discussion of the hazardous features of the tobacco industry of today it is timely to interject here an excerpt from an article written a number of years ago by an underwriter of prominence, and published in the American Exchange and Review of Philadelphia. It is an able contribution to insurance economics as related to the subject in hand and clearly outlines the underwriting considerations of the times which applied to the tobacco industry.

Many changes have occurred in the intervening years, principally in the method of conditioning tobacco, and elimination of heavy taxation and also in the conditions surrounding speculators' barns or leaf houses and tobacco manufactories, all of which are dwelt upon, but

many of the considerations apply in this day, thus adding to the article's historical value:—

The Tobacco Fire Hazard, Moral and Physical.—Four classes are before us of which to estimate the fire hazards: First, the farmer's barn; second, the leaf house; third, the manufactory; and fourth, the stemmery.

The **farm barn**—used for housing and curing tobacco only—has a physical hazard greater than that of any other frame built produce barn (dry tobacco being no more inflammable than hay) only during the curing and stripping periods; and, as a rule, but little moral hazard, if values are properly cared for. During the processes of curing and stripping, however, or with privilege of firing tobacco, or curing by fire, no rate is adequate; and they should be, and are, then practically uninsurable. While the leaf is still green and moist it will not burn with any degree of freedom, but as the curing approaches completion danger from the cause indicated is imminent.

At the stripping stage it is probably even more so. Carried on in winter, a fire for warmth is of course necessary. The hands employed are usually women, or the colored men of the vicinity, not specially gifted with the bump of caution. They sit around the fire, and as the leaves are stripped the stalks are thrown carelessly around—perhaps even on the very verge of the embers. If ignited these stalks will smoulder throughout their length, as a slow saltpetre fuse does—naturally so, for the stalk actually contains a small proportion of nitre. The hands stop at nightfall, heedlessly leaving things as they were, fire and all.

Again, if there is any ill-feeling extant between the planter and his helps, the "poor colored man" chooses this season to give it vent. He knows as much of the physical hazard as any of us, and calculates on it as a tolerably secure method of averting suspicion from him, should any be likely to arise.

This time passed in safety, however, there seems no good reason why the farm tobacco barn should not be as good a risk as the average farm barn.

The speculator's barn, or re-drying and handling houses—**leaf houses** in fact—present another phase of hazard; quite a disastrous one, I am sorry to say, and mainly of the immoral sort. There are many such risks in all tobacco counties, and fires among them lamentably frequent. The leaf house being purely a speculative affair, ephemeral in its character—here this season and away the next—it is without the care and protection of employees hired continuously by the year. The stock being held for the most part for sale in local markets, is manifestly directly affected by the fluctuations of these markets, and they are neither few nor small. Suppose the general crop exceeds the conjecture, or that the market is moving slowly, or any of the hundred causes arise which upset calculations of profit, or entail positive loss, it can readily be seen that if the dealer in futures happens to have two or three fair-sized policies in his safe, he has a strong temptation, if not a direct incentive, to drop a lighted candle or something else where it will do most good.

In tobacco **manufactories**—at least in some sections—the ratio of losses has been very serious, especially in view of their known inherent hazard.

The state of Missouri, which has heretofore grown comparatively little more tobacco than was required for her home manufacture, has been prolific of fires in her factories. These, with leaf houses, were her two chief classes of hazard, and both have proved notably unprofitable as insurance risks.

In Kentucky, Louisville being the central point for this branch of the trade, the case has stood almost the same. During the period which has

elapsed since the war, an average say of twelve factories—of any extent—have been in operation there per annum, and three-fourths of that number—one every fifteen months—have caused serious losses. It is singular, however, to know that in none of these cases could the case, apparently, be fairly attributed to any of the processes carried on therein. One (in an old frame building) was, in all probability, incendiary. Another (brick) the same, with suspicion attaching to the owners. A third arose in the boiler house; while a fourth fire was accounted for by lightning following the attraction of a pipe into the drying room—a singular example of the prevalence of habit, when even the forces of nature cannot resist the temptation of trifling with the weed, and so on. Richmond, Va., on the contrary has been fortunate with her factories, none, as I am informed by the secretary of one of the local companies, having burned there in the last twelve years. On the other hand, as has been stated to me, Petersburg and Danville factories in the same state have proved quite disastrous, notably in the former city, at least seven of them burning one after the other. It is proper to say, however, that these followed hard upon the close of the war, when the probability is they were worked during unsettled markets by parties of small capital, and but little knowledge of, or capacity for, the trade.

Latterly, matters having drifted back into their more legitimate condition, this moral hazard seems to have ceased (the causes were in no case ascertained to be physical) and a better experience reigns. Losses, however, are not infrequently quite severe, not only from the fire, but the consequential damage always to be looked for as an important factor in risks of the class from water or smoke, or both, often worse than the other. A comparatively slight exposure to either of these damages is pretty sure to entail very considerable loss.

The government tax, too, forms quite an item in augmenting this beyond even the actual or intrinsic damage, as—in the lower grades especially—the tobacco cannot bear the cost of putting it in something like order again, and the import also. For example: Of a very cheap smoking tobacco, five cents' worth has a tax of twenty-four cents to carry, the manufacturer, of course, being out of poeket for the necessary stamps at least sixty days, and so on up. Obviously, it would not pay him if the intrinsic value were diminished ever so little to prepare it for market, and a really slight damage might thus entail a total loss on such tobacco, or very nearly so. * * * * Rates should be according to construction of the buildings, and extras say, first, in proportion to the number of hands employed, as indicative of the extent of the work and the chances arising from a large number of careless negroes, women or children, skilled labor being but little needed; second, for the position of boiler or flues, and their relation to the factory proper; third, for making packing boxes or cases in factory; fourth, for drying room, according to construction and location; fifth, for boiling the sweetening mixture inside, otherwise than by steam, and so on. This would seem to be more practical and reasonable than the present system, and might yield better results.

The fire hazard of the **stemmery** I have reserved till the last. The buildings are, with very few exceptions, either entirely frame—as best adapted for maintaining an agreeable atmospheric condition—or have the first story brick, and the superstructure (three to four floors additional) frame, with numerous window openings, unglazed, having adjustable shutters or slats thereto, to admit of the free circulation of air during good drying weather, or its exclusion during the reverse.

They are almost all detached, no smoking is allowed, and have no fire

heat in the premises unless it be a securely erected stove in the office, and another in the stemming room, there being one such room in each stemmery. The rest of the ground floor is used for bulking and prizing, and the upper stories for hanging and air-drying. No machinery is used, the work is done entirely by hand.

These are the general and almost unvarying features. The stemmers are, as a class, numbered among the best and wealthiest citizens of their states, and their risks carry absolutely no moral hazard with them. Rich, they are able if necessary to carry their tobacco over for several seasons, and frequently do so; whilst buyers who procure advances get them from England at a small percentage, and can never know the outcome until long after shipment. Most of the stemmers are connected in Liverpool, London, or Glasgow, and control the stocks there. They are entirely above and aloof from local ups and downs; their work is done on a prospective profit, quite independent of ruling prices here, and for which they are well able to wait. When the leaf enters the stemmery it is practically entirely withdrawn from the American markets altogether, and from any market affecting the stemmer or shipper for at least a year.

The stemming season lasts from two to six months, usually commencing about the first of February. * * * * The fact is, that there is no class of risks in which fire hazard has been proved to be less than in tobacco stemmeries, and in their history in Kentucky we can hear of no instance in which fire has occurred in the stemming room or through the processes of handling.

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Let us here see more closely what are the physical characteristics attaching to stemmeries in their relation possible to losses therein: first, their extent, construction, and open ventilation; second, the degree of rapidity with which the hanging tobacco, assisted by above aids—though not in itself excessively inflammable—will carry the flames; third, the very small chances for salvage in the event of a fire getting any hold, and of very extensive damage through smoke, even should it not spread much.—*A. M. Cunningham.*

Now continuing consideration of the features of hazard attending the practices in vogue in the tobacco industry of these times.

Tobacco Barns. (Vide October, 1907, issue, page 12, "Curing"). The first hazardous condition met with on the journey of the leaf from the field to the consumer is in the curing barn or as it is also termed, the farmer's barn, where artificial heat, intermittent or continuous, is used in curing.

Tobacco barns may be classified as follows according to their excellence as insurance risks:

1. a. Air curing barns, no heat, no stripping.
   b. Air curing barns, no heat, with stripping.
2. a. Air curing barns, intermittent heat, no stripping.
   b. Air curing barns, intermittent heat, with stripping.
3. a. Heated curing barns, continuous heat from flues, no stripping.
   b. Heated curing barns, continuous heat from flues, with stripping.
4. a. Heated curing barns, continuous heat from open fires, no stripping.
   b. Heated curing barns, continuous heat from open fires, with stripping.

The addition of stripping operations in a curing barn contributes more chances of fire than if the stripping were done elsewhere. The reasons why are aptly explained by Mr. Cunningham in the above reprint. All barns do not contain stripping rooms, and aside from the fact of additional hazard, stripping room occupancy means that so much more of the valuable leaf is held in the building subject to one fire. This is especially interesting as the hazard of the curing operation increases. The old saying of "too many eggs in one basket" fits the condition exactly. Not very long ago, a Connecticut barn burned; loss several hundred thousand dollars.

Barns classed No. 1 in above list are usual in the Cigar Leaf districts of Connecticut, Pennsylvania and Florida. No heat whatever is used in curing. In the northern districts the time of stripping the leaves from the stalk is generally in cold weather so if the stripping rooms are in the barn (and if they are they are generally in the basement) stoves are used for heat; also artificial lighting is oftentimes necessary and for this gas, electricity or oil lamps are used. See page 13, October, 1907, issue.

Barns classed No. 2 are also in Cigar Leaf districts but where conditions are somewhat different from above. Cigar tobaccos in Ohio and Wisconsin are air-cured but intermittent heating is often necessary in very wet weather. This is had from small stoves and lighted lamps, sometimes from small open fires of wood and charcoal; and in a few cases from stoves. The introduction of a flue heating system in some of these barns has been talked of. See page 19, October, 1907, issue.

The intermittent use of heat in barns where such heat is more the exception than the rule, is often marked by carelessness and indifference in properly arranging and safeguarding the heating apparatus. In experimenting in the introduction of the Sumatra seed leaf in the Connecticut Valley the government experts resorted to intermittent heating in their curing barn on bad days. The barn burned. Too much care cannot be exercised in properly establishing heating apparatus in barns of this class. Such heating apparatus should be permanently established in conformity with the best practice and not carelessly set up and dismantled after use as is the prevailing practice where enclosed fires are used.

Continuously heated barns, that is heated for curing purposes, classed No. 3, **flue barns,** are principally found in the Bright Yellow districts of North Carolina and Virginia. These barns are described in detail on pages 16, 17 and 18, October, 1907, issue. The improved or, so-called, patented barn is to be preferred to the ordinary barn. The furnaces and flues in any type of barn cannot be too carefully installed. Sometimes the flues get red hot and their close proximity to the walls of the barn or leaf hung above is unsafe. The barn illustrated on pages 16, 17 and 18, October, 1907, issue, should prove a reasonably safe type and flues would be much safer if vented into brick chimneys built up from the ground. The best of these barns might be recognized as insurable property but those of the ordinary type are often quite impossible as such.

Another hazard in flue barns is in the practice of throwing wet

straw on the flues after curing is completed to humidify the air so that the leaf will be brought into good "order" for "striking."

Barns continuously heated by open fires during curing, classed No. 4, are in vogue in the Dark Export tobacco region of Kentucky and Tennessee. See pages 13 and 15, October, 1907, issue. The open fires are generally of hardwood so as to insure a minimum of smoke. The best arrangement of fires is in holes or pits dug in the floor of the barn some seven or eight feet deep. This precludes disturbances from draughts, to which the fires on flat floors are often subjected causing them to blaze up, and also such pit fires are much better regulated. In barns with flat floors the fires are often built between two parallel logs. The distance that the bottom of the leaf is above the fire is possibly not more than six feet and may be less. These fires have to be carefully attended for if they blaze up there is great danger of setting the tobacco afire. Many cases have been recorded, especially about Hopkinsville, Ky., where barns burned because of carelessness in firing and sparks from firing. This method of firing is peculiarly necessary in curing the Dark Export variety of tobacco and cannot well be replaced by any other.

In the Census of 1880 reference was made to the frequency of fires in curing barns as follows: Air barns, less than 1%. Barns heated with open wood fires, 2-3%; with charcoal and flue fires, 3-5%. This somewhat reverses the order given by the writer but out of 64 barn fires recorded in five years, 1897-1901, 34% were in open fired barns and one-half of those were in and about Hopkinsville, Ky. Of these 23% were in Connecticut in air barns. The balance scattering, but principally in Massachusetts, Wisconsin and Tennessee. The chief causes observed as having caused fires in air barns are unsafe stoves and their flues in stripping rooms, incendiarism, and lightning.

Sales Warehouses. While there are no hazards of consequence in first-class warehouses there have been and are some undesirable conditions in them as for instance camping, stabling and hanging of leaf tobacco. In the old days farmers coming a long distance would have to wait over for a sale and would "camp out" in the warehouse and stable their teams there and possibly some leaf that had gotten wet would be hung to dry, maybe in large quantities, all of which would detract from the excellence of the Sales Warehouses.

Storage Warehouses. These vary in excellence according to their nature and in some cases are confounded with Prizeries as in case of the jobber speculator or leaf handler in whose premises tobacco is kept oftentimes in storage. Storage Warehouses proper are occupied exclusively for storage of tobacco in hogsheads and other packages and are generally in connection with tobacco manufactories in cities and towns. There are no hazards except those consequent upon some undesirable conditions of administration and occupancy. Care and cleanliness should be well looked after. Camping, stabling or hanging of leaf tobacco should not be permitted and warehouses should not be occupied even for offices or sample rooms. All packages of tobacco should be piled on skids. "Sweating" is often done in warehouses and does not add anything to the hazard. Dealers' Warehouses have

to be differently considered as the same conditions of excellence as in Manufacturers' Warehouses cannot prevail.

Prizeries, Stemmeries and Leaf Houses. Under this caption can be included practically all of the varied types of risks wherein tobacco is handled intermediately between Sales Warehouses and Manufactories. Today Prizeries and Stemmeries are very similar in their physical nature, notwithstanding what they might have been at the time written of in Mr. Cunningham's article. The principal hazard in this class is in drying tobacco in drying machines and special rooms. The extent of the hazard depends upon many things all of which were treated of in the special chapter on that subject. Construction and arrangement were also specially treated. (Prizeries and Leaf Houses particularly.)

Also in this class are hazards consequent upon certain defective moral conditions more especially of the past than of the present. In the old days before manufacturers became heavy direct buyers much speculation was rife, and if no other sale could be made, one could be made to the insurance companies. However the day of the "pin-hooker"—the speculator—has passed and likewise a bad fire record.

The hanging of leaf tobacco is not so general in these risks as in former days. Some leaf however cannot well be handled in the machines and rooms and is hung up to dry in the old way. This condition at once exposes much tobacco to smoke damage and adds much fuel for a fire.

Tobacco Manufactories. The hazards attending the conversion of the tobacco leaf into salable product can be more briefly considered by assertion than by deduction.

In **Cigar Factories** there are no special hazards attending the process of manufacture. Cigar making machinery does not constitute a hazard. The use of saltpetre to improve burning qualities and rum for flavoring would necessitate the storage of such materials which would constitute a moderate hazard. Drying operations are unusual in cigar factories.

Cigarette Factories. The process of drying and nature and amount of flavoring materials are principal items of interest. Considerable glycerin is used.

Pipe Smoking Tobacco Factories. The operations of drying, granulating and flavoring are of chief importance. Apropos of drying reference should be had to the Chapter on Drying Apparatus. Granulating tobacco is seemingly more hazardous than it is practically. See pages 42, 43 and 44, October, 1907, issue. Much dust arises from the granulating machines which in suspension in air in proper proportion would make an explosive combination that could be readily ignited by a spark struck in the cutting apparatus by a nail passing through. Some special machinery such as that of the Adt make is equipped with magnets and blower fans which prevent nails and other foreign material from entering the machinery. In several factories where trains of cutters, graduated from coarse to fine, are used, no effort is made to arrest all of such material before entering the first cutters except what the fan and seive after the breaker shake out. Between each of the successive machines are blower fans and shakers which rid the tobacco of foreign matter before it reaches the smaller granulators.

This process is always very dusty. The dust is carefully collected, cleaned in a reel, sacked and shipped to snuff factories. The flattening and drying of stems is an item of interest. See page 45, October, 1907, issue.

Flavoring materials consist largely of rum, tonca bean and licorice, which means that large quantities of spirits are kept on hand. Often quite a few barrels of rum are exposed during the day in these factories. In August, 1907, a fire occurred in the rum locker of a North Carolina tobacco factory caused by some one endeavoring to steal rum. All stocks of spirits are generally concentrated in one spot and kept under lock and key. This is generally in the main building. Such stocks would be better outside in a special house and just a daily supply brought into the building. Licorice is cooked these days in steam jacketed kettles, see page 46, October, 1907, issue. There used to be a time when fire heat was used and—well the losses were settled the same as other losses. Licorice kettles should be set up from the floor and away from the wall and the floor thereunder should be sheathed with sheet metal and kept clean.

Plug Tobacco Factories. The processes of especial interest are: Flavoring, drying "dipped filler," and "bulking." See pages 45 and 48, October, 1907, issue. Flavoring generally of sweetened licorice. Licorice cooked as above described. Drying and "bulking" previously considered.

Snuff Factories. See pages 50 and 52, October, 1907, issue. In these factories the principal processes are : Drying or toasting, grinding and snuff elevators. The nature and safeguarding of the drying hazard should be carefully observed. Dry snuff is milled to an impalpable powder while moist snuff is ground with considerable moisture in it, to a "flour." Grinding dry snuff is of course more hazardous as it entails drying previous to milling and much dust is created. Bolting reels for cleaning dry snuff are generally above the grinding mulls and the snuff is conveyed up by belt and bucket elevators. The hazard of these elevators is commonly understood in connection with flour mills and fires have occurred in them in Snuff Factories. The strut boards should always be inclined, and the legs should be of metal instead of wood. The hazard from tobacco dust mixed with air is understood without comment. Such a hazard however is remote in snuff factories. Various flavorings and perfumes are added to the snuff and also such salts as carbonates, chlorides and sulphates of potassium and sodium and carbonate of ammonia, none of which materially add to the hazard.

Miscellaneous Hazards. In some large tobacco manufactories many of the things contributing to the industry are gathered under one roof. Tin, paper, cloth and other packages in which the manufactured product is packed, as well as the wooden cases in which they are shipped, are made there. Likewise is done the necessary printing and lithographing. All of these operations add their incidental hazards, with which the reader is doubtlessly familiar.

In Tobacco Extract Factories probably the chief hazard is in drying and grinding of tobacco stems. Hazards which are clearly understood without comment.

Fumigation Against Insects. A hazard of considerable importance has developed in the tobacco industry in recent years. In 1900 and 1902 the United States Department of Agriculture published bulletins describing the nature of and remedies for insect pests in tobacco. Liberal excerpts from these bulletins are herein reprinted which fully cover the question from the reader's point of view.

The following are excerpts from Farmers' Bulletin No. 120. The Principal Insects Affecting the Tobacco Plant. By L. O. Howard, United States Department of Agriculture:—

Of the principal insects affecting the tobacco plant, the Tobacco Horn Worm and the Cigarette Beetle are susceptible of extermination through the agency of Carbon Bisulphide as an insecticide.

Tobacco Horn Worms.

Most tobacco growers have learned by experience the necessity of carefully removing the worms from the leaves after or during cutting and before they are carried into the barn, since otherwise they will continue to feed in the barn on the drying leaves. Where such care has not been exercised, the evaporation of bisulphide of carbon in the barn, in accordance with the directions and with the precautions which will be described under the head of remedies for the cigarette beetle, will kill the worms before they can do further damage, and the quality of the tobacco, as we have proved by experience, will not be injured in the least, the reverse being the case when the smoke from a damp wood fire is used, as it is sometimes for this purpose.

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The Cigarette Beetle.

Of the insects injurious to cured tobacco none approach, in economic importance, the species which has become known as the cigarette beetle.

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Working as it does in all kinds of cured tobacco and living in this substance during all stages of its existence, it damages cigarettes and cigars principally by boring out of them, making round holes in the wrappers so that they will not draw. Leaf Tobacco is injured for wrapping purposes by being punctured with holes made both by the larvæ and the beetles, and fillers and fine-cut are injured by the reduction of their substance by the actual amount consumed by the larvæ.

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The cigarette beetle is practically cosmopolitan, and probably occurs in most tobacco factories in the southern states, as well as in most wholesale drug stores. In the far South this insect multiplies rapidly throughout the greater part of the year, and its development is practically continuous in artificially warmed factories farther north.

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It is only within comparatively recent years that the cigarette beetle has become at all serious to tobacco manufacturers in this country, but it has been increasing and spreading of late, and at the present time it is found not only in many factories, but also in warehouses, tobacco barns, and retail establishments. The writer knows of one little shop into which it was accidentally introduced in some plug tobacco. It increased, entered the show cases, and ruined a large number of high-priced cigars and cigarettes. The shopkeeper was in despair, but finally, at

the advice of the writer, submitted his entire stock to fumigation with bisulphide of carbon, and thus completely rid his establishment of the beetle.

Remedies.

With a small establishment like the one just mentioned, it is a comparatively simple matter to destroy the insect by means of the fumes of bisulphide of carbon. The place was clean and well-swept and dusted, and all that was necessary was to have a tight case (a show case was used) and the entire stock of tobaccos, cigarettes, and cigars was placed in the case in installments, and a saucerful of bisulphide of carbon was evaporated over night. In the morning the contents of the case were removed, the store was aired, and the next night another lot was fumigated. For some time after this experience the shopkeeper in question used the same case as a quarantine box, and put all of the tobacco which he bought through the fumigating process before he placed it on his shelves.

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In a large factory, however, the case is, of course, very complicated. The average factory is not a clean place. It is frequently an old building, roughly built, with innumerable cracks in the floors and walls, which, in the course of years, have become filled with tobacco dust and fragments. Even the crevices about the windows are filled with comminuted tobacco. Frequently large stocks of tobacco are kept on hand a long time. When the cigarette beetle has once obtained a foothold in such an establishment, it is a matter of considerable time, expense, and energy to get rid of it, and at the same time it is as much as the reputation of such a factory is worth to allow goods to go out containing any specimens of the insect in any form.

There is an unfortunate and, the writer believes, wholly unjustified prejudice against steaming tobacco. Experiments carried on by Professor Atkinson in 1885 or 1886 showed that proper steaming will destroy this insect in all of its different stages, and the practical experience of several tobacco manufacturers, whose establishments have been visited by the writer, has indicated the same thing. With this knowledge, therefore, barring prejudice, there is no reason why a tobacco manufacturer should ever put out any infested tobacco. It becomes important, however, to entirely rid his establishment of the insect, and here nothing but heroic measures will avail. Taking a room at a time, the floor and walls must be thoroughly cleaned, the walls whitewashed, and all beams and floor cracks subjected either to steaming or to thorough spraying with kerosene or benzine, great care being taken to avoid fire in case the latter substance is used. Benzine is preferable to kerosene on account of its greater volatility, in that the establishment can be more readily rid of the odor, but it is more dangerous on account of its higher inflammability. The beetles are quite inclined to fly to the light and to settle about the windows; therefore the window cracks should be especially looked after. With such a thorough treatment as this, taking room after room, the writer feels sure that the insect can be exterminated in almost any tobacco factory.

Where it is not desired to use steam, experience has shown that, as above indicated, bisulphide of carbon may be used to good advantage. With leaf tobacco such a fumigation must be very thorough to kill the insects embedded in the mass of leaves. Experiments made in the writer's office with hydrocyanic-acid gas show that it is not to be compared in efficiency with bisulphide of carbon for this work. While the bisulphide treatment is preferably made in a tight bin, it may also be carried on in a tight room. In either case one ounce of the liquid should be evaporated for every 62½ cubic feet of space, or one pound for every 1,000 cubic feet.

Every precaution should be taken, however, to see that the room is perfectly tight, and also that no fire is allowed to enter the room until after it has been most thoroughly aired. The vapor of bisulphide of carbon in confinement is inflammable and explosive.

In cigar and cigarette factories much that we have just said will be applicable. The tobacco, before use, should be steamed, if possible. Loose tobacco should not be left exposed at night. Boxes or piles of cigarettes or cigars, after being made, should be covered very tightly to prevent the access of the beetles. * * * * * *

The following are excerpts from Farmers' Bulletin No. 145. Carbon Bisulphid as an Insecticide. By W. E. Hinds, United States Department of Agriculture:—

Properties of Carbon Bisulphid.

Carbon bisulphid is a colorless watery liquid, formed by the union of two elementary particles of sulphur with one of carbon (charcoal). Its chemical symbol is CS_2. It is made on a large scale by passing the fumes of burning sulphur over red-hot charcoal. The resulting vapors are condensed to a liquid form by cooling, and the impurities are removed therefrom.

Liquid Properties.

The liquid is one-fourth heavier than water, its specific gravity being 1.29 at the freezing temperature of water. * * * It is very volatile, evaporating with great rapidity when freely exposed to the air. The rapidity of evaporation depends mainly upon the area of the evaporating surface and the temperature of the liquid and the air. It may be retarded by mixing the liquid with various substances, and is wholly prevented by covering the surface of the carbon bisulphid with a layer of water, which, being lighter, floats easily on top just as kerosene does upon water. * * * Liquid carbon bisulphid is not at all explosive, so there need be no fear of handling it, providing the cans are perfectly tight. It is best kept in an out-house where there is no fire and where it is dry, so that the cans will not rust and allow the vapors to escape through leaks. The liquid boils at 115° F., but a few degrees higher than the temperature of the human body. One volume of the liquid is said to give 375 volumes of vapor upon evaporation.

Vapor Properties.

The vapor of carbon bisulphid is 2.63 times as heavy as air, and can, therefore, be poured from one glass to another almost like water. It can be seen flowing down over the edge of an open vessel containing the liquid. Although it diffuses quite rapidly through the air, as can be perceived by its odor, it is evident that the vapor will always tend to work downward more strongly than upward and that it will always be more dense at the lower levels. This point should be borne in mind, as it has an important bearing upon the application of the bisulphid. The vapor, as well as the watery solution, is a powerful disinfectant.

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Ignition Temperature of Carbon Bisulphid Vapor.

The temperature at which the vapor ignites when mixed with air is given in chemical text-books as 300° F. * * * In the experiments made in the Bureau of

Chemistry it was found that the vapor could not be ignited at 296.6° F., but twice it took fire at 297.5° F.

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Mr. C. E. Monroe in an address before the American Chemical Society says: "One of the most striking characteristics of the mixture which this vapor forms with air is its low point of ignition. The tiniest spark, a cinder after it has ceased to glow, or the striking together of two pieces of iron without sparking are sufficient to determine the ignition." In the open air the line of ignition appears to be quite close to that of the liquid itself as is stated by some writers and shown in some experiments by the author; but Dr. C. V. Riley once stated that the vapor ignites "at a great distance from the vessel containing it." In a closed space the ignition depends upon the presence of the vapor in proper proportions and may take place at almost any distance from the liquid. This explosive property of the mixture of the vapor with air is similar to that of alcohol, petroleum products, etc., though its ignition temperature is much lower. The flame extinguishes itself in a closed vessel which does not allow access to the air.

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Chemical Experiments with Carbon Bisulphid.

The vapor * * * burns with a faint blue flame, with difficulty visible in daylight, but evolving considerable heat and decomposing the carbon bisulphid into carbon dioxide (CO_2) and sulphur dioxide (SO_2). * * Carbon bisulphid vapor mixed with three times its volume of oxygen, or an amount of air containing that amount of oxygen, forms a mixture which is very highly explosive upon ignition. * * * An atmosphere composed of one volume of carbon bisulphid vapor to approximately 14.3 volumes of air is liable to violent explosion in the presence of fire of any kind whatever, or at a temperature of about 300° F. without flame. We have here about the maximum danger point from explosion in the use of carbon bisulphid.

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The danger from its use is practically of the same kind as that from gasolene, which is in common use in thousands of homes. Really, the danger is very much less, since every precaution is taken to keep carbon bisulphid from the proximity of fire, while gasolene is used principally in connection with fire.

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Diffusion of the Vapor.

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This vapor diffuses through the air very rapidly and must, therefore, be closely confined in order to maintain a sufficient proportion of it in the atmosphere to prove fatal to insect life. It tends most strongly to spread outward and downward on account of its being so heavy, and, though it will gradually work upward, its greatest density will be at the lowest levels. The usual calculation is to employ one pound of liquid carbon bisulphid to each 1,000 cubic feet of space treated, whether for the treatment of insects in buildings or for insects in the ground. This amount gives an atmosphere, if confined to that space, composed approximately of one part in 90 of carbon bisulphid vapor, which, as we shall see, is a fatal strength in a short time. However, where the atmosphere can not be absolutely confined and there is considerable opportunity for the vapor to escape, it is frequently necessary to apply from two to four times that amount, under circumstances where there is no danger of killing plant life.

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How Put Up.

Carbon bisulphid is put up in tight tin cans or iron drums holding from one to 50 pounds.

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Treatment of Stored Products.

The Fumigation of Buildings.—Carbon bisulphid is used in fumigating milling establishments, warehouses, storage rooms, grain elevators, stores, houses, barns, etc., for the destruction of insects affecting stored cereals and vegetable products, manufactured food products, dried tobacco and its various products, drug-store insects, and household insects which may be sufficiently numerous or injurious to warrant such treatment. Besides being efficient for the destruction of such insects, it will also kill other animals, such as rats and mice, which it may reach.

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Preparations for Treatment.—The building should be made as tight as possible.

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Shallow tin pans or plates make good evaporating dishes. The larger the evaporating area the better. There should be about one square foot of evaporating surface to every 25 square feet of floor area, and each square foot of evaporating surface should receive from one-half to one pound of the liquid. * * * Pans should be placed as high in the room as possible, since the vapor is so heavy that it settles most heavily to the lower parts. * * * If there are special places which are difficult of access or treatment with the pans, cotton waste, bundles of rags, or the like may be saturated and thrown into these places. Everything should be done to avoid unnecessary delays and to facilitate the rapid exposure of the liquid. If the liquid is bought in large quantities, smaller receptacles may have to be provided for transferring it to the pans.

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* * * Before the cans or drums are opened the men should be cautioned as to the nature of the liquid, the danger from fire, and the necessity for rapid work. If more than one floor is to be treated, begin at the bottom and work upward. * * * The best plan usually is to apply the liquid after work hours, but before dark, on Saturday evening, and leave the building closed till the following Monday morning.

* * * Doors and windows are then opened wide, at least one or two hours before it is time to resume work. The vapors disappear rapidly in the open air, and after an hour there will ordinarily be no danger in entering and but little trace of the disagreeable odor. Slight traces of the odor will probably linger in corners and places where the air does not move freely, but these gradually disappear.

* * * Attention has been called to the dangers from fire in the presence of carbon bisulphid vapor in the air, but special reference should be made to it in connection with the treatment of buildings. It is customary to mention the danger of bringing a lighted cigar or any such thing into the presence of the fumes. The application should always be made in daylight, as no artificial light of any kind is allowable. Even electric lights may not be used, since, when turning them on or off, there is always danger of producing a spark, which would prove disastrous if the vapor should be present in the proper proportion. Heated steam pipes constitute another danger to be guarded against, and they should be allowed to cool before the application is made. Electric fans must not be run, as they very frequently give off sparks. It is safer to have no heat of any kind in the building while the exposure is being made, and it is a matter of courtesy, as well as a precaution, to warn

the owners of adjoining premises of the nature of the work being done, and the need for care if the vapors should penetrate to their rooms to any extent. It would be an added measure of safety to have a watchman to guard the premises from the time the application is made until the ventilation is complete.

As yet there has been but little use, if any, made of this remedy for insect pests. It is probable though that, as its virtues are advertised, it will be more widely used with, it is to be feared, disastrous results in some cases if the directions are not carefully followed.

General care and cleanliness is a most important thing in tobacco factories. Numerous references have been made to indifferent care and poor physical condition of these risks and there is no good reason why this should be so. However the industry of today is better organized and in better hands than in former years so these conditions have improved. Yet not in all cases. In December, 1907, a small fire occurred in a North Carolina prizery from the ignition of refuse in contact with steam pipes. A steam pipe fire and in a tobacco risk! Fortunately the risk was equipped with automatic sprinklers as otherwise it—well, the cause would not have been ascertainable.

Fires in tobacco risks outside of those in dryers have been more often from common and direct and indirect moral hazards than from Special Hazards. In a well-known insurance paper in the early 80's appeared an article on tobacco risk hazards and one reading it would suppose that the tobacco industry was full of hazards. There has been much play of imagination in contemplating hazards in this industry. Direct moral hazard is a resort to arson consequent upon individual misfortune, trade depression or other depressing circumstances. Indirect moral hazard is illustrated in indifference to proper construction and prevention and protection against fire. The tobacco industry has been teeming with these conditions. See Miscellaneous Considerations following:

The following are some of the causes of fires in tobacco risks aside from dryers: carelessness with matches; greasy overalls; spontaneous heating of ink on printed signs in piles; ignition of celluloid cigar cases; scrap wood breakers in box departments; lightning; electric wiring; defective chimneys; tobacco dust on boilers; incendiary; exposures; etc.

MISCELLANEOUS CONSIDERATIONS.

Economic History. Inasmuch as the rise and progress of the tobacco industry occurred chiefly in the State of Virginia a brief sketch of the economic history of the industry in that state might not be amiss.

Prior to the Civil War tobacco manufacturers were distributed throughout all of the producing sections. Not only in the homes of the planters but in small factories in country districts tobacco was manufactured. In 1860 there were 252 factories in Virginia. One hundred and nine of these were in Richmond, Petersburg, Lynchburg and Danville. The balance, 143, were in the country towns and villages. After the war the country factories almost disappeared. In 1870 only 131 factories existed in the state, and the number of city

factories were reduced fully 40%. This was caused by the effects of the war, scarcity of labor and the heavy tax the Government imposed.

During the period 1871-1885 improvement took place. Manufacturers having recovered from losses occasioned by the war and becoming better used to the burden of the tax began to forge ahead, enlarge their business and extend trade. There was no concentration of factories but the outlying country factories were abandoned and factories developed in small towns on railroads. In 1880, Virginia had 199 factories. The improvement over the conditions in 1870 were very considerable.

Two new branches of the industry developed during the prosperous period, viz.: Rehandling or prizing and cigarette manufacture. The object of rehandling was to properly condition the leaf for warehousing or transportation. In 1880 there were 27 of these establishments and 1890, 101.

In 1890, Virginia had only 93 factories. All of the small factories were forced out of business by that time and from then on was a period of cutthroat competition of large manufacturers in marketing goods. These conditions were very unsatisfactory to all concerned. The consumer was cheated, the price of leaf tobacco depressed and manufacturers were forced to resort to doubtful practices. Plainly it was necessary to adopt some measures to bring an end to this ruinous competition and unfair methods.

In 1890, The American Tobacco Company was formed. First it was a union of several of the largest cigarette manufacturers of different sections of the country, but has since been extended to include manufacturers of other forms of tobacco. The panic of 1893 greatly stagnated the industry, some manufacturers were driven to the wall and the tobacco trade further concentrated into the hands of large corporations.

Whatever that may be said against trust oppression and the like, the fact remains that the tobacco industry of today is highly organized with better manufacturing practice and improved conditions in factories. All of which is in sharp contrast to the conditions of a quarter of a century ago.

Great havoc is being wrought by associations of planters, in their fight against the associations of manufacturers, i. e., the Tobacco Trust, especially in the Dark Export region of Kentucky and Tennessee. Incendiarism is rife and much property is being destroyed. The reader is no doubt well informed about these conditions, through the current press and periodicals. These conditions mark another epoch in the economic history of the industry and whether or not the planter can sell the leaf at his own price in the market time alone will decide.

Susceptibility of Tobacco.

The question of the **susceptibility** of tobacco to consequent damage by smoke and water and salvage after a fire, is well covered in the following reprint from "Insurance Engineering," Vol. II, No. 4, October, 1901, page 358:

Cigar Leaf.—This caption embraces tobacco used in making cigars, and

grown in the United States, Cuba and Sumatra. The quantity coming from other places is unimportant. It should be subdivided thus:

Domestic Cigar Leaf.—United States, or domestic cigar leaf, is principally grown in Pennsylvania, Wisconsin, Connecticut, New York and Ohio, and being made up in hands of from 15 to 25 leaves each, is packed in wooden cases weighing 300 to 400 pounds each. The contents of these cases is either fillers, binders or wrappers, and the value of same about 10, 30 and 60 cents per pound, respectively.

Havana, or Cuban.—This tobacco is packed in bales weighing from 100 to 150 pounds, and is covered with bast, a Cuban vegetable product, impervious to water, and around the whole is a bale cloth of heavy linen. Bast is used in Cuba for roofing the huts of the country working people. Probably 95 per cent. of this tobacco is fillers, and sells for 35 cents to $1.25 per pound. The average price approximates 50 cents in bond.

Sumatra.—This tobacco, the product of the Island of Sumatra, mostly comes to us from Amsterdam, and is used wholly for wrapping cigars. It has no value for anything else, and its use for wrapping purposes is because of its silky appearance and elastic texture. It is packed in bales weighing 150 to 200 pounds, with a covering of East Indian matting and gunny cloth, neither of which will shed water. It sells for an everage of $1.00 a pound in bond.

Hogshead Tobacco.—In Kentucky, Virginia, North Carolina, Tennessee, Maryland, and, to some extent, in Ohio and Missouri, tobacco is grown that is used for smoking, chewing and cigarettes, and is packed in hogsheads weighing about 1,500 pounds. The bulk of it is known as lugs, and sells for an average of 6 cents per pound. The leaf is thick and heavy, with large veins.

Conclusions.—Tobacco may be damaged by fire, smoke or water. When consumed by flames it matters not whether it is of one kind or another. When damaged by smoke or water, or both, the loss on domestic cigar leaf will be greater than on hogshead tobacco, and on Havana tobacco greater than either, and on Sumatra more than all. So that in its susceptibility to damage, leaf tobacco must be classed: 1st, Sumatra leaf; 2d, Havana; 3d, United States; 4th, hogshead. And why is this? Because:

Sumatra leaf is used solely for wrapping cigars, and elasticity is essential to its usefulness. Drench it with water, and if left for 48 hours it will become so tender that it will be a total loss. It cannot be doctored or manipulated for other use. Hence I place it first.

Havana leaf is more liable to severe damage from smoke than from water, its taste being its prominent feature. If smoke damaged it may not be fit for use in making clear Havana cigars, but can be mixed with domestic tobacco and retain a fair percentage of its value. If water soaked it can be dried and used even in scraps without losing a great deal of its value.

United States, or domestic cigar leaf, is a large leaf, seldom measuring less than 15 inches in length, and while suffering from water and smoke as other tobacco does, it always has a value. The wrapper, the most perfect and valuable leaf, if damaged or torn may be used for a binder; or if the binder is damaged it has use as a filler. The filler of this kind of tobacco is used in cheap cigars, and great injury would have to occur before its usefulness for cigars would be gone, and even then it would have some value as a fertilizer.

Hogshead tobacco is the least likely to sustain loss from smoke or water. The bulk of it has licorice and tonca beans mixed with it in considerable quantities when made into plug or chewing tobacco, and opportunity for doctoring damaged leaf is abundant. It is hard to see how a hogshead of tobacco, unless actually submerged, could be damaged more than 33 1-3 per cent. by water, and even then could be dried out with good results if done in time to prevent mold. Being heavy-bodied stuff, in the event of damage so that it cannot be used in manufacture, it has 10 to 20 per cent. value left as fertilizer.

Fire Protection. It is only since the tobacco industry became more concentrated and better organized that there has been much improvement in protection against fire. Even today many risks, where the contained values warrant a good investment in improved fire protection, are without it. Automatic sprinklers are of greatest value and outside hydrant protection should always be available. Other features of fire protection and alarm service should be considered as individual risk conditions warrant.

In conclusion the writer offers his apologies for taxing the reader's patience. His knowledge of the subject is limited. Maybe it is just as well that it is, as the subject is teeming with interest and more, much more, could have been written.

IRA G. HOAGLAND, *Inspector,*
The South-Eastern Tariff Association.

A Method for the Classification of the Hazardous Properties of Certain Liquids.

PART II.

As the fire hazard of ether is represented by 100 the following relative values may be assigned to the characteristics indicative of its hazard:

1.	Explosive characteristic; including the relative range of explosibility of ether vapor	27
2.	Combustibility; as indicated by the flashing point	23
3.	Volatility; as indicated by the (a) vapor pressure at 68° F. (b) boiling point at standard pressure	25
4.	Violence of vapor air explosions	10
5.	Vapor density	5
6.	Ignition point	3
7.	Resistance when burning to the extinguishing action of water	3
8.	Chemical activity. Hazards in combination	2
9.	Ability as a corrosive agent	1
10.	Ability towards leakage	1
11.	Ability as a factor in spontaneous ignition	0
	Total for ether,	100

Characteristic 11 (qv) is not considered least in importance, but is placed at the end of the list merely for convenience.

Characteristics 1, 3, 4 and 5 are rated with reference to the flashing point. The flashing point is in this way made a determinative factor in rating the hazard and is not, therefore, considered separately. In the case of liquids which do not have the characteristics 1, 3, 4 and 5 in a marked degree the rating received for cumbustibility covers the hazard that would be indicated by the flashing point.

Let us briefly consider the comparative values of the above characteristics.

The Explosive Characteristic.

This term is used herein to indicate the ability of a liquid under certain conditions to give off vapors which when mixed with air in certain proportions (explosive range) form an explosive mixture. It appears that the explosive characteristic is the most hazardous characteristic considered and is accordingly given the highest value with respect to ether and certain other liquids. The conclusion is based on the fact that certain liquids, which field experience shows are especially hazardous, such as ether, gasolene, benzine and the like, have this characteristic, while

certain highly inflammable liquids which have in common with ether, gasolene, benzine and the like all of the principal characteristics enumerated except the explosive characteristic, are considerably less hazardous.

The particular value 27 was assigned to the explosive characteristic of ether simply because this value, when applied consistently to the explosive characteristic of ether and certain well-known liquids, in connection with the values assigned to the other characteristics, gives results which appear to be in accordance with available data having a bearing on the fire hazard. All the values we are putting forward were determined in this way. These values may then be considered as a working hypothesis.

The value of the explosive characteristic of liquids does not appear to be in direct proportion to the relative range of explosibility. In other words, in the case of vapors the value for a range of 10 (numerals referring to explosive range are here used to indicate the limits above and below which no explosion occurs) is not necessarily twice the value for a range of 5. The approximate relative explosive range of ether vapor, for instance, is 6, while the relative explosive range of gasolene vapor is about 2.3, yet there is but little difference in their hazards as indicated by their explosive characteristics. See curves Nos. 1, 2 and 3.

It will be seen on examining these curves that the explosive characteristic is rated with reference to the flashing point according to a curve. The same form of curve is used in rating characteristics 2, 3, 4, 5 and 6. Its use for the above purpose is based on the following considerations:

In the case of given liquids, other characteristics being equal, the lower the flashing point, the higher the relative hazard. The hazard, however, is not in direct proportion to the flashing point. It is evident that the relative hazard per degree Fahrenheit between 400° and 240° (equal 160°) is less than it is per degree Fahrenheit between 240° and 80° (equal 160°) as the latter temperature is within the zone of average room temperature; nor will a degree Fahrenheit be equivalent to as much, in terms of relative hazard, below average room temperature as it is at the upper limit. At 400° F. then the curve in question nearly coincides with a straight line, while at 105° F. it nearly coincides with the arc of a circle. If the curve were extended so as to take in a temperature of 40° F. it would be very nearly a straight line at that point.

Combustibility.

Ether would have no explosive characteristic if its vapor were not combustible. However, under combustibility we consider different phenomena than that considered under the explosive characteristic. There is a difference in degree. Certain combustible vapors under the conditions we have to deal with are not highly explosive; their combustibility, however, is a factor that must be reckoned with.

The combustibility as considered is, therefore, closely related to the explosive characteristic and appears to be second in importance. It will be noted that the volatility of ether is assigned a higher value than the combustibility. This was done because ether is an extremely volatile liquid. In the case of most liquids the volatility will occupy third place in relative importance.

Volatility.

The following data relative to the volatility or tendency to evaporate of certain liquids as measured by their vapor pressure is compiled to show the relation between vapor pressure in cubic centimeters of mercury and actual loss of volume in cubic centimeters (1 ounce=29.5 c. c.) per hour from a beaker 77 mm. (Approx. 3 in.) in diameter.

	Vapor pressure at 68 degs. F.	Loss per hour in c. c. at 68 degs. F.
Kerosene,	.3	.13
Turpentine,	.4	.17
Distilled water,	1.74	.29
50% water, 50%-95% alcohol,	2.6	.79
95% commercial alcohol,	4.5	.88
Completely denatured alcohol,	5.5	.98
Gasolene 66°	6.6	1.32
Wood alcohol,	8.8	1.56

The volatility of a liquid is not in direct proportion to its hazard. See curves Nos. 5, 7, 8, 9, 10, 11, 12, 13, 14 and 16. The most important question relative to the volatility of a liquid is whether it evaporates at average temperature sufficiently rapidly to become hazardous.

Violence of Vapor Air Explosions.

The force of a vapor air explosion depends, among other things, on the nature of the vapor and percentage of vapor in the explosive mixture. The results of such measurements, I think, for our purpose would hardly be worth while from a practical standpoint.

The most important question in this respect is whether the vapor of a liquid under ordinary conditions forms a mixture with air which in contact with a flame explodes with (1) great violence or (2) violence, or (3) merely forms a quick burning mixture. The above can be readily determined. See curves Nos. 17 and 18.

The Remaining Characteristics.

Characteristics 7, 9 and 10 are given relatively small values. They may be considered as indirect factors in regard to the fire hazard of liquids. On account of their small relative values they are not considered with reference to the flashing point.

Inflammable liquids which are lighter than water and are also immiscible with water are very difficult to extinguish with water when burning, so to speak. Other liquids are miscible with but lighter than water. The latter are less difficult to extinguish when burning with water. The following rating was determined upon for this class of inflammable liquids:

Liquids—(a) Lighter than and immisicible with water. 3.
(b) Lighter than and miscible with water. 2.
(c) Heavier than and immiscible with water. 1.

Characteristic 8 is rated 2 in the case of ether. In other liquids the rating of this characteristic will depend on the nature of the chemical combinations likely to occur in practice. It will have to be especially considered in each case.

Characteristics 9 and 10 are each rated 1 for ether and 2 for liquids possessing these characteristics in a greater degree.

Ability as a Factor in Spontaneous Combustion.

It appears that this well-known characteristic should be considered in each special case, and such a value assigned to it as experimental data and the history of the liquid in question seem to warrant.

Summary.

In case of spindle oils the above method may be used to classify their relative hazards in regard to storage. When in use, however, spindle oils are likely to be heated to 150° F., the temperature generally attained by a bearing after running a few hours. The volatility of spindle oils should, therefore, be measured at 150° F. by heating approximately .2 grams of the oil for eight hours at this temperature and noting the loss. An oil which shows a loss of over 5% by weight should have, I think, a value of 30 on account of volatility.

The following case is cited to illustrate the way in which the curves can be used to ascertain the relative hazard of a liquid.

Grain alcohol has a minimum explosive range 9.6. See curve for vapors with explosive range 9; follow this curve until it intersects the vertical line running through the flashing point 61° F. (The flashing point of grain alcohol.) Then follow the intersecting horizontal line to the relative hazard scale, noting the hazard. It is in this case one space above 19 and equals approximately 19.3. Follow the curve for each characteristic possessed by the liquid in like manner and add the values together, dividing the total by 10. The result shows the relative hazard according to this method.

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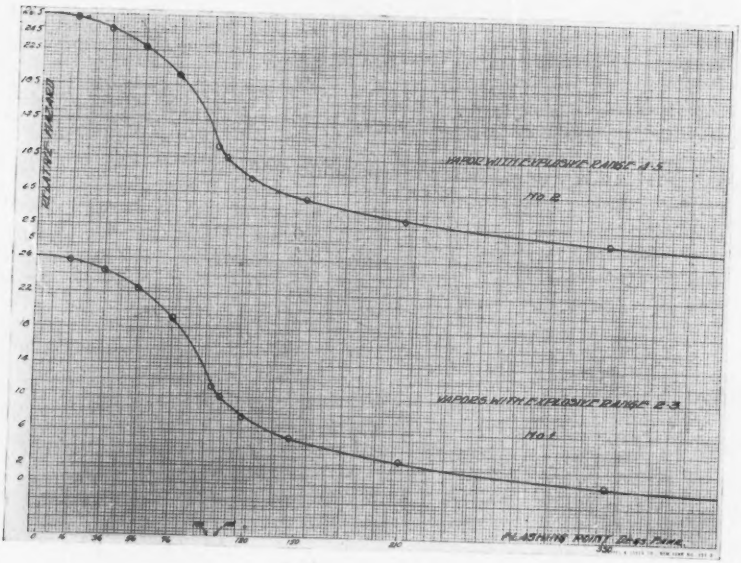
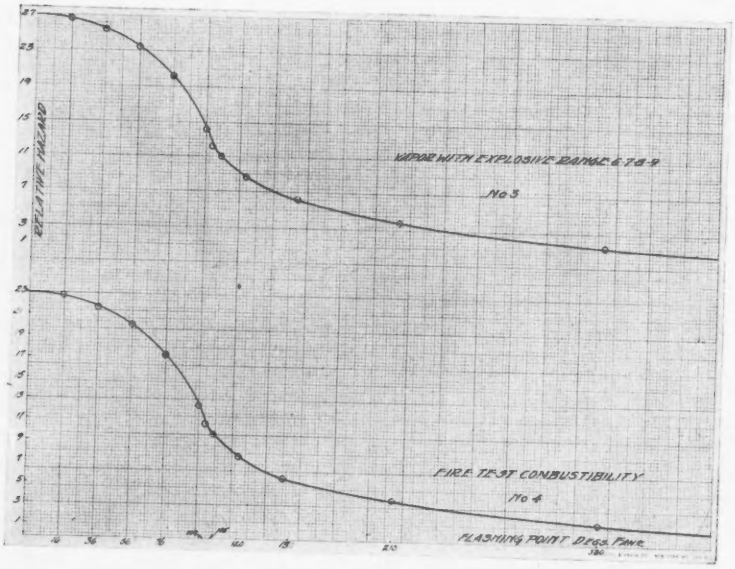
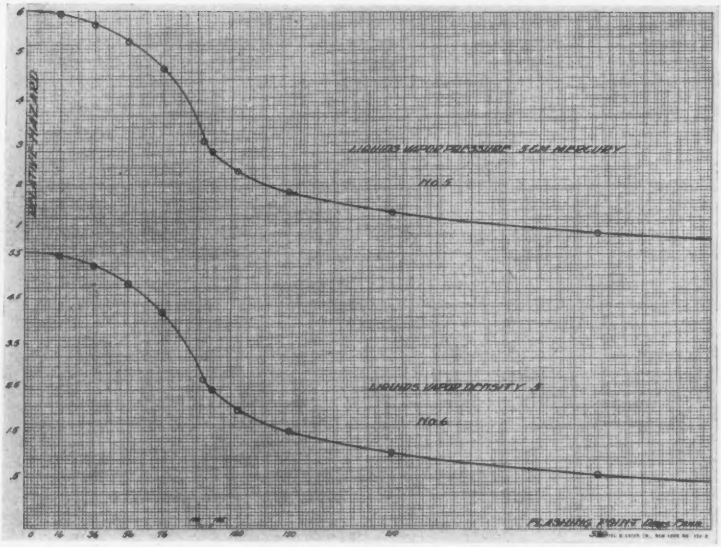
The Underwriters' Laboratories, Inc.


RELATIVE HAZARD
VAPOR WITH EXPLOSIVE RANGE 1-5
No. 2
VAPORS WITH EXPLOSIVE RANGE 2-3
No. 1
FLASHING POINT. Degs. Fahr.


RELATIVE HAZARD
VAPOR WITH EXPLOSIVE RANGE 6.7 & 9
No. 3
FIRE TEST COMBUSTIBILITY
No. 4
FLASHING POINT. Degs. Fahr.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No. 5
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No. 6
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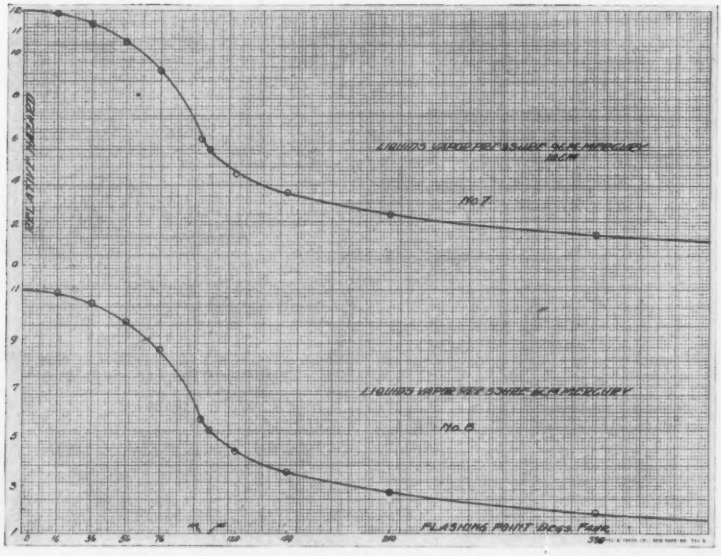
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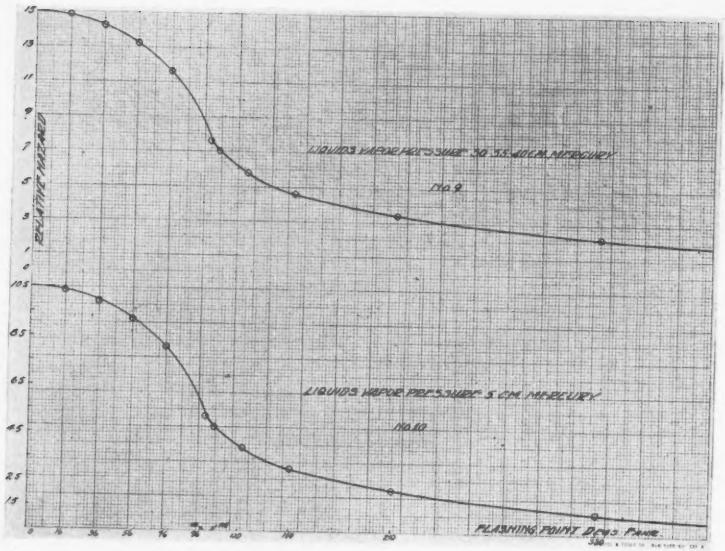
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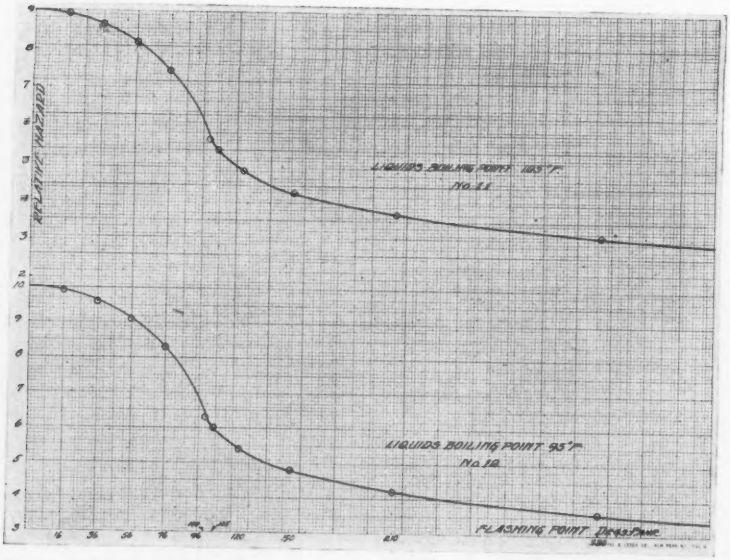
No. 9.
LIQUIDS VAPOR PRESSURE 5 CM. OF MERCURY.
No. 10.
FLASHING POINT DEGS. FAHR.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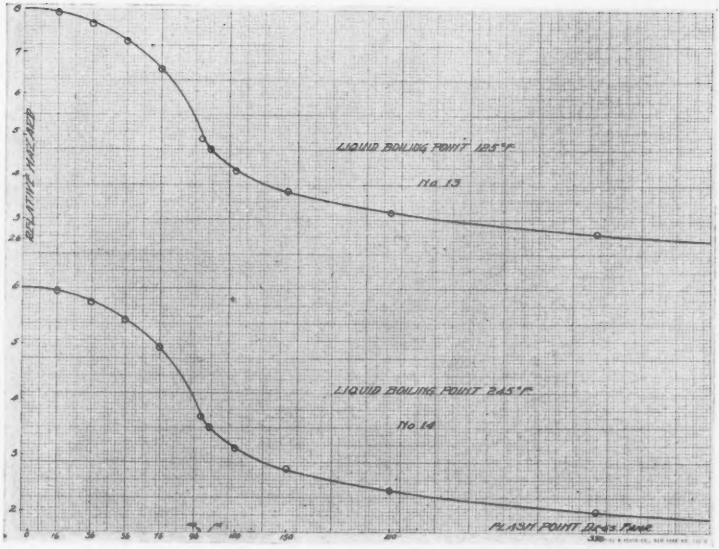
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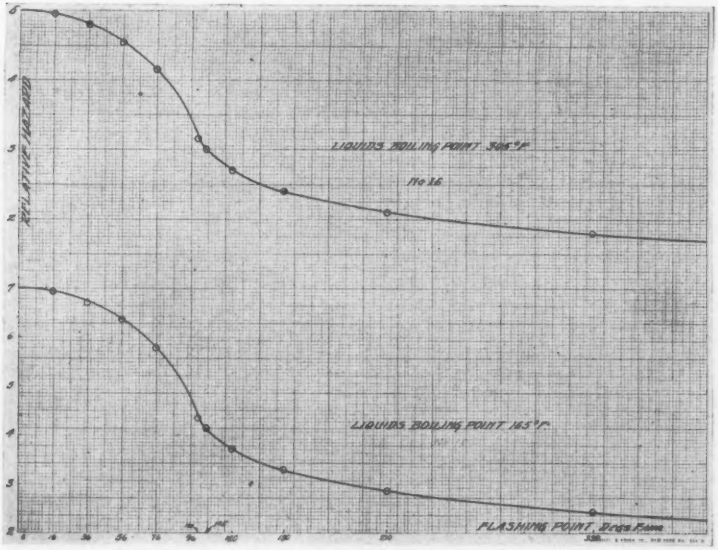
No. 13
LIQUID BOILING POINT 245°F.
No. 14
FLASH POINT Tag's Test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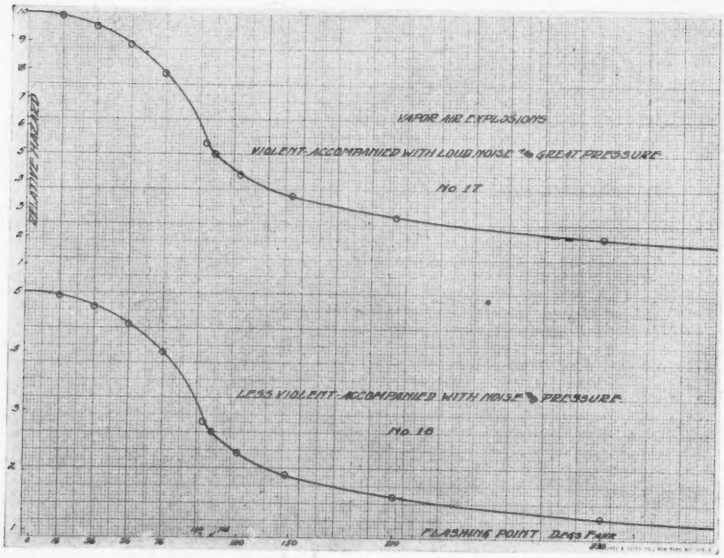
FLASHING POINT Tag's Test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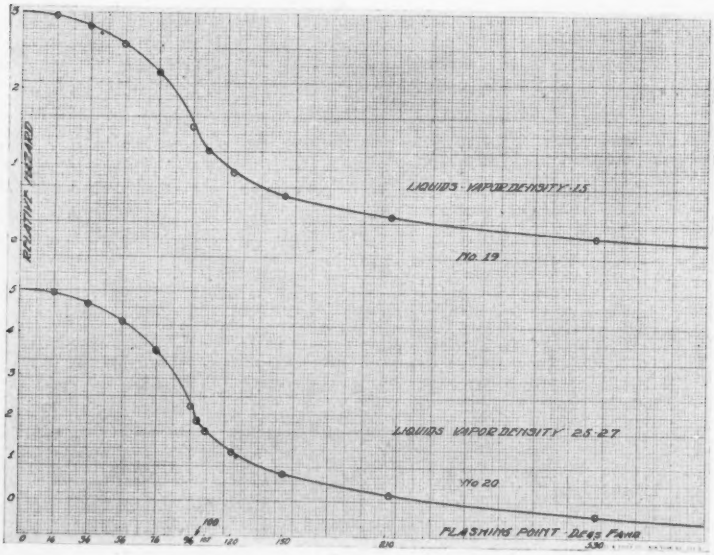
VAPOR AIR EXPLOSIONS
VIOLENT ACCOMPANIED WITH LOUD NOISE & GREAT PRESSURE
No. 17
LESS VIOLENT ACCOMPANIED WITH NOISE & PRESSURE
No. 18
FLASHING POINT Degs Fahr


EXPLOSIVE VALUE
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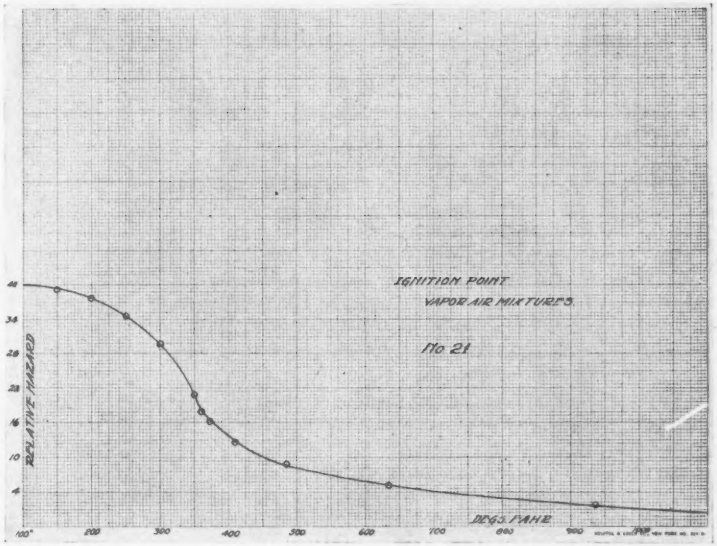
LIQUIDS VAPOR DENSITY 2.5-2.7
No 20
FLASHING POINT Degs Fahr


IGNITION POINT
VAPOR AIR MIXTURES
No 21
RELATIVE HAZARD
DEGS. FAHR.
100°
200
300
400
500
600
700
800
900
FOR

CLASSIFICATION OF CERTAIN WELL KNOWN HAZARDOUS LIQUIDS ACCORDING TO ABOVE METHOD.

	Explosive Characteristic	Combustibility	Volatility: Vapor Pressure at 67 degrees F.	Volatility: Boiling Point	Violence of Vapor Air Explosions	Vapor Density	Ignition Point	Resistance when Burning to Extinguishing Action of Water	Chemical Activity	Ability towards Leakage	Ability as a Corrosive Agent	Total	Class
Ether	27	23	15	10	10	5	3	3	2	1	1	100	10
Carbon Bisulphide	27	23	15	8.5	10	5	10	2	2	1	2	105.5	10
Gasolene	26	23	11	7.4	10	5	3	3		1	1	90.4	9
Benzine (Petroleum Product)	26	23	11	7	10	5	3	3		1	1	90	9
Benzene ($C_6 H_6$)	26	23	11.7	7	10	5	3	3		1	1	90.7	9
Alcohol (wood)	24	20.3	10.5	6.4	4.5	1	3	2	1	1		73.7	7
Alcohol (denatured)	23.6	20	9.3	6.3	4.5	2.5	3	2	1	1		73.2	7
Alcohol (grain)	22.6	19.3	5.2	6	2.5	2.4	3	2	1	1		65	6
Kerosene	11	10.6	3	3.1		1.8	3	3		1		36.5	4
Turpentine	11	10.6	3	3.1		2.5	4.5	2				36.7	4
Linseed Oil *25		1.		1.5			3	2				32.5	3
Paraffine Oil		.8		1.5			3	2				7.3	1

* For spontaneous ignition 25

A. H. NUCKOLLS, B. A., *Chemical Engineer,*
The Underwriters' Laboratories, Inc.

Metal Workers.

Note.—The following has been written as a suggestion or outline for a series of papers on the various classes of manufacturing properties, to be prepared and presented to our Association by the Committee on Special Hazards through its Sub-Comittees. It is not intended to draw up or adopt a standard but rather as is outlined in the following introduction to give to the public such information as we think would be of benefit. These papers can, if desired, be presented to our Association at its annual meetings, discussed and changed as may be necessary, accepted and printed in pamphlet form for distribution as giving the best information at our command.

This article on Metal Workers is not as complete or correct in its details as desired, partially on account of lack of time and the large field covered, but it is hoped that it will be discussed in a general way at our next meeting with reference to the scheme as a whole, and then if desired referred to the Special Hazard Committee for further investigation and report.

HENRY A. FISKE, Chairman,
Committee on Special Hazards and Fire Record.

INTRODUCTION.

The following suggestions on Construction, Protection, Care of Hazards, etc., are intended to serve as a guide to the manufacturer or property owner desiring reasonable protection against fire. They are not to be considered a "standard," nor will a property constructed or protected along these lines necessarily secure the lowest insurance rates, this latter feature being entirely in the control of the Underwriters having jurisdiction, who should always be consulted. These suggestions are merely an outgrowth of a desire on the part of the National Fire Protection Association to give to the public the best information at its command regarding the various classes of manufacturing properties. Reference is made to the various Rules and Requirements of the National Fire Protection Association and the National Board, these being printed in pamphlet form for free distribution and they can be obtained as desired from the Underwriters having jurisdiction or the organizations themselves. The Rules which may apply are as follows:

Acetylene Gas and Calcium Carbide, Coal Gas Producers, National Electric Code, Fuel Oil, Gas and Gasolene Engines, Gasolene Lighting, Storage of Inflammable Fluids, Mill Construction, National Building Code, Oil Rooms, Skylights, Signalling Systems, Automatic Sprinkler Systems, Open Sprinklers.

The following devices and materials have been standardized or approved, lists issued, and only such apparatus should be installed as is acceptable to the Underwriters having jurisdiction:

Fire Doors and Shutters, Wired Glass Windows, Chemical Extinguishers, Waste Cans, Water Pails, Hose and Hose Houses, Hydrants, Pumps (Steam, Rotary or Electric), Watchman's Clocks, Thermostats, Automatic Sprinklers and other devices connected with these systems.

The large and important class or industry commonly called Metal Workers may be considered to include those properties where metal in the form of pigs, bars or sheets constitutes the raw stock, also those which use metal stock which has already passed through one or more of the preliminary metal working processes, such as casting, rolling, forging, etc. It might also be quite properly considered to include the wrought iron and steel industry where the iron ore is converted into iron or steel billets, bars, ingots, etc., and then formed into the finished products such as plates, bars, structural steel, rails. While however this latter important class is a part of the metal industry it may be considered as separate from the metal workers proper (i. e. workers of metal) and from the standpoint of construction and fire hazards it requires different treatment. The class of Metal Workers would also not ordinarily include the mixed metal and wood workers such as Agricultural Implements, Carriage Factories, Automobile Factories, etc., except as to the metal working processes. The woodworker hazard however is necessarily combined to some extent with the metal workers in that many of the latter do a considerable amount of pattern making which introduces woodworking processes, and to this extent it is necessary to treat of these hazards.

In order to obtain a better idea of the diversified nature of the Metal Workers some of the better known classes may be mentioned as follows: Metal Beds, Boiler Works, Bolt and Nut and Screw Works, Cutlery and Hardware, Engine Works, File Works, Gun Works, Jewelry Factories, Metal Lamps and Lanterns, Nail Factories, Pin Factories, Rivet Works, Rolling and Wire Mills, Saw Works, Silverware Manufacturing, Stamping and Sheet Metal, Brass Works, Machine Shops.

Iron and brass foundries or casting shops are also included and these processes play an important part in many classes of metal workers.

In the treatment of the construction, protection and hazards of the various metal working classes no attempt will be made to outline the processes or hazards of any one class. The metal workers will be treated as a whole and generally speaking the same process or hazard should have the same treatment regardless of the particular class in which it may occur. The ordinary manufacturing plant will be first considered, that is, the class of metal workers which uses metal stock and by machinery shapes, stamps, presses, cuts or otherwise works the metal into the finished article, except that the finishing process proper, such as painting, japanning, lacquering, etc., will be treated separately as will also what may be called the preliminary processes of casting, forging, melting, rolling and wire drawing, annealing, etc.

THE ORDINARY MANUFACTURING METAL WORKERS.

CONSTRUCTION.

Walls and Floors and Roof. For this class of risk standard brick mill construction is recommended (see N. F. P. A. rules and requirements). This includes the heavy tight plank floors without openings,

resting on heavy wood timbers and wood columns. The timbers to be self-releasing and preferably spaced not over eight to ten feet apart. Fire resistive construction, such as steel frame protected by terra cotta or concrete, or reinforced concrete, is of course somewhat more desirable than any wooden floor building. On the other hand, it is somewhat more expensive and there are operating advantages in the buildings with wooden floors and ceiling. If building is of fire resistive material it should be constructed in full accordance with the National Building Code.

Floor Openings. All stairways and elevators, also beltways if any, to be in brick shafts with standard automatic fire doors at all openings.

Height. Buildings should be as low as feasible, not over three stories in height.

Area. The area should be sub-divided with standard cut-off walls (see N. F. P. A. rules and requirements), so as not to exceed 5,000 square feet, this division of area however being more important with two and three-story buildings than with one story.

Special. Such manufacturing hazards or processes as need special constructive treatment will be taken individually.

COMMON HAZARDS.

Power. The power plant containing boilers for heating and power, engines, dynamos, etc., should preferably be detached or if this is not feasible it should have a standard cut-off from adjoining buildings. This portion of the plant should be constructed entirely of fire resistive material such as brick or reinforced concrete, including roofs and floors, to be one story, preferably without basement. If desired a wooden floor may be used in the engine room if laid directly on concrete.

Power if electric to be installed in accordance with the National Electric Code. If by gasolene gas engine or producer gas, to be installed in accordance with the rules and requirements of the National Board. Shafting should be well hung and provided with self-oiling bearings with oil drip cups. Bearings to be kept clean.

If fuel oil is used for heating boilers or for other processes it should be installed in accordance with the rules and requirements of the National Board. Soft coal is subject to spontaneous combustion and should be stored in detached coal sheds where it can be easily handled in case of overheating.

Heating. To be by steam, hot water or hot air. Steam pipes should be securely supported and have iron bushings where passing through woodwork. They should be kept clean and free from combustible material. Where hot air is used, air should be taken from outside and the blower and intake should be located in a suitable room with wall partitions and ceiling protected by wire lath and plaster or other acceptable non-combustible covering so as to eliminate as much as possible the danger of fire originating in this room. Bearings on blower should be kept clean, well oiled and properly cared for. The intake should be of metal and the opening screened and located so as to be safe from sparks. The hot air should preferably be conveyed to the various floors through brick flues with metal dampers. Metal hot

air pipes passing through floors or walls (with the possible exception of outside walls) is not acceptable.

Lighting should be by approved electric or gas systems.

If electric to be installed in accordance with the National Electric Code.

If gas, jets to be made stationary where practicable and when so located that they can come in contact with woodwork or other combustible material jets to be protected by wire globes or guards, or to have proper ventilated shield.

Any form of lighting other than electricity or gas may increase the hazard and in any event, such lighting must be installed according to the rules and requirements of the National Board.

A shut off valve should be located outside of the building, easily accessible, so that in case of fire supply of gas can be cut off promptly.

If gasolene or acetylene gas is used it should be installed in strict accordance with the rules of the National Board.

Rubbish, Sweepings and Oily Material. Good housekeeping is the best preventative of fire. The factory should be swept up daily and the refuse conveyed to boiler house and burned. If necessary to store it temporarily there should be a fire-proof vault with standard cut-off from boiler house. Waste or refuse chutes are undesirable. While cleaning up and removing, refuse should be placed in standard metal barrels. (See rules and requirements of the N. F. P. A.) Waste that has been used should be kept in standard waste cans (see rules and requirements of the N. F. P. A) and when past its usefulness should be at once burned.

Matches, and Smoking. The promiscuous use of matches inside of building should be prohibited. Lighting of gas jets should be done by the foreman. Safety matches only should be used. Smoking should be prohibited and signs posted to that effect.

SPECIAL HAZARDS.

Oils. Main supply of oils should be kept in detached oil house of fire resistive construction. Where essential to keep a fairly large supply of oil inside of factory proper, it should be stored in a standard oil room. (See rules and requirements of the N. F. P. A.) It should be remembered that mineral oils will not ignite spontaneously whereas vegetable or animal oils will readily ignite with waste, sawdust, etc., so that the hazard is lessened where the pure mineral oils are used.

Sawdust should not be used for catching oil drippings because of the danger of spontaneous combustion. Oily metal chips or filings should be collected in metal cans and piled outside where they can do no harm as they are liable to ignite spontaneously.

Acids. Main supply should preferably be stored in detached noncombustible building used for that purpose only. Nitric acid will if spilled on paper, straw, etc., ignite same. The wooden hoods and ventilating flues over acid dipping tanks are peculiarly susceptible to ignition from open lights or corroded light wires.

Forges. The small shop or portable forges can be safely arranged inside of the main building although the general process of

forging should always be carried on in a separate building as hereafter noted. The flooring under and around forges should be brick, cement or concrete. The hood or metal flue should be a foot or more away from ceiling and should enter a properly constructed chimney or flue preferably outside or a part of the outside wall. This chimney or flue to be of brick and at least eight inches thick. There should be no wood or other combustible material nearby. Charcoal if in shop should be kept in standard metal cans as should also the hot ashes. Many fires are caused by sparks from forges or hot metal igniting combustible material and this danger should be clearly recognized.

Furnaces. The general processes of melting, annealing or hardening will be treated later. Small furnaces heated by coal, gas, fuel oil, etc., are however often used in metal working processes such as brazing, welding, annealing, etc., and may be properly safeguarded and used in main building. They should be treated similar to the forges mentioned above except that the heat radiated is generally greater and there is even greater necessity for keeping combustible material away from the immediate vicinity. If several of these furnaces are used they should preferably be located in a room cut off by a fire resistive partition of wire lath or expanded metal and cement or its equivalent, with fire doors at any openings. Floor to be of brick or concrete and ceiling to be protected in a similar manner to partitions. Numerous fires have occurred from these small furnaces due to ignition of woodwork of floor or partition.

Tinning. These furnaces are particularly hazardous because of the molten metal and this process should always be located in a cut-off room as mentioned above or in a detached, separate building.

Soldering. This is a very common hazard in metal workers and a frequent cause of fire. Soldering iron furnaces are generally heated by gas or charcoal. Bench on which they rest should preferably be of metal or they may be placed on a short legged metal table resting on the ordinary bench. If heated by gas, the jets should be secure, not movable, and if bench is of wood the jet should be a safe distance above so as to preclude any possibility of overheating woodwork. Gasolene soldering pots are especially hazardous and should not be used. If necessary to use one temporarily it should be filled outside and removed from the factory after using.

Oil Tempering. This is a hazardous process and should preferably be carried on in a detached building specially constructed for the purpose. If necessary for the process to be in the main building it should be carried on in a room cut off and fireproofed as mentioned above under furnaces. There should be a sill at the doorway about two inches high and floor should pitch to drain outside. The standard oil room construction could be used to advantage. No combustible material should ever be allowed in the oil tempering room.

Buffing and Polishing. Because of the difficulty in carrying off the lint and dust this process should be in a room shut off from other processes. Especial care should be used as to cleanliness and room should be cleaned up daily. The oil and lint from the buffing wheel is especially susceptible to spontaneous combustion so that sweepings and refuse from this room need more than ordinary care. There should be a complete and powerful blower system to convey the buffing

dust to an outside dust box or house of fire resistive construction. Where necessary to reclaim the precious metals the dust is generally blown into boxes or tanks partially filled with water and these boxes if of combustible material may ignite from the accumulation of the buffing dust on the surface of the water or in the corners of the box.

Gas Burners for Bench Work. Ordinary gas burners or Bunsen burners are frequently used and often cause fire by igniting combustible material nearby or the bench on which they may rest. These should be solidly fixed in position and a safe distance from any combustible material.

Benzine or Gasolene. These inflammable compounds are frequently used for cleaning purposes to remove oil, etc., and the usual precautions should be followed. Where possible these compounds should not be brought into the building and the metal or parts should be cleaned in a detached or cut-off building. The main supply should be kept in a detached oil house and its use in handling carefully regulated. The use of benzine and gasolene for thinning japan or similar compounds is treated under that specific hazard.

Celluloid. This compound is frequently used in metal workers, such as jewelry and novelty factories and especial care should be taken as to its storage and use. For details see special report on Celluloid issued by the N. F. P. A.

Pitch. This compound is often used in silverware factories and similar risks. It has to be melted and steam heat only should be used. Main supply should be stored outside.

INSIDE PROTECTION.

Automatic Sprinklers. Factory should be equipped throughout with a standard automatic sprinkler system except that the power plant if detached or cut off and of fire resistive construction throughout need not be so equipped. (See rules and regulations of the N. F. P. A. on Automatic Sprinkler Systems.) The water supplies and other special features to be determined by the underwriters having jurisdiction.

Water Pails, or Standard Chemical Extinguishers. A supply of standard fire pails should be provided (see N. F. P. A. rules and requirements). The approved hand portable chemical extinguisher has been proven to be of much value in extinguishing incipient fires. Only such extinguishers as have been tested and approved and labeled by the Underwriters' Laboratories should be installed. Where benzine, oils, varnishes, etc., are used a liberal supply of pails filled with clean dry sand should be provided.

OUTSIDE PROTECTION.

Where risks have satisfactory outside protection from town or city fire department, private hose service would not generally be necessary unless the property is of large size. It is evident that with large properties employing reliable male help it is feasible to provide prompt and fairly efficient private hose service, this of course necessitating private yard hydrants, hose houses and equipment. It also means a private drilled fire brigade in order that the apparatus may be intelligently

handled. The laying out of private outside protection requires the services of an expert fire protection engineer and the underwriters having jurisdiction should always be consulted. There are N. F. P. A. rules covering underground piping, hydrants, hose houses and other equipment and private fire hose, all of which should be consulted and followed.

ALARM SERVICE.

Watchman. Except as hereinafter provided there should in all cases be a standard watch service consisting of a reliable, intelligent, able bodied man making at least hourly rounds, covering all portions of the property and making a record of these rounds on an approved stationary or portable clock. Only such clocks as have been approved by the Underwriters' Laboratories and bear their label should be used. Rounds should be made nights, Sundays and holidays or whenever the plant is not in full operation. It is preferable to have the rounds made every half hour and it should be remembered that one of the great weaknesses of watchman service is that fire may start at a time when watchman is in other portions of the plant. The watchman stations should be so located that he is obliged to pass through every important room, except those rooms where inflammable liquids are kept or used, and these should be preferably locked by the foreman or superintendent and not entered by the watchman. The watchman should not have other duties than watching the plant. Other men should be provided for sweeping up, closing windows or shutters, tending fires, etc. The clock dials should be changed every day by someone other than the watchman, dated and kept on file for reference. In cities or other localities where central station watch service is provided such service is entirely acceptable and in some cases is to be preferred to the ordinary watchman clock. The watchman's first duty should always be to ring in the fire alarm. He should be thoroughly acquainted with all of the fire protection appliances and their uses.

Automatic Fire Alarms or Thermostats. In some localities this class of alarm service is considered the equivalent of watchman service especially in towns or cities where central station connections can be provided. The underwriters having jurisdiction should always be first consulted and if thermostats are acceptable in lieu of watchman service only approved types of thermostats should be installed, and the equipment should in all respects conform to the rules and requirements of the National Fire Protection Association. Risks having pump supply or private hose service should have a watchman in preference to automatic fire alarm owing to the fact that an intelligent watchman can be of much assistance in extinguishing fire when first discovered.

Automatic Sprinkler Alarm. Every sprinkler equipment should be provided with an approved sprinkler alarm valve connected to local bells (electric alarm, water motor alarm or both) and if possible there should also be a direct connection to a central station or the nearest fire department house. The arrangement, wiring and other features of sprinkler alarm service should be installed in accordance with the rules and requirements of the National Fire Protection Association and the underwriters having jurisdiction should be consulted as to acceptable devices, location of bells, etc. This form of service is valuable not

only because of the fact that an alarm is given if fire opens the sprinklers but also because an alarm will be given in case of a break or abnormal leakage in the sprinkler system.

Sprinkler Supervisory Service. This service may be considered to include the sprinkler alarm proper and to also include a means of notification in case of any trouble with the sprinkler gate valve or the tank supplies. The service should be connected with a central station where men are on duty at all times so that an investigation may be made in any case of trouble. Only such systems as are approved by the National Fire Protection Association should be used and they should be installed in accordance with their rules. An attachment is provided on each sprinkler controlling gate valve, so that in case valve is closed for any reason someone is notified and the matter investigated. The level of water in gravity tank and the temperature of the water, also the maintenance of air pressure in pressure tanks is supervised. This service is recommended for best protection.

Manual or Auxiliary Fire Alarm. An approved system of manual boxes located at various points throughout the risk is considered as giving valuable protection. The auxiliary box connecting direct with the fire alarm box or the fire alarm service combined with central station watch service is generally considered acceptable, but underwriters having jurisdiction should always be consulted. All systems of this class should be installed in accordance with the rules and requirements of the National Fire Protection Association. Alarm boxes should be located at convenient and easily accessible points such as near stairways or watchman stations. Watchmen and employees should be acquainted with the location of such boxes, and the ringing of alarm should always be the first duty when fire is discovered. Auxiliary alarm systems are especially desirable in large plants or where the regular fire alarm box is some distance from the risk. These systems can be arranged to ring local bells in addition to giving the regular fire notification, thus quickly calling the employees for such assistance as they may be able to render.

Public Fire Alarm Boxes. One should always be located at the property. It is preferable to have this a private box so that there can be no question as to the location of the fire. With large or important properties it can be arranged so that the private box will call out a larger force than would the ordinary street box.

EXPOSURE.

Internal, or exposure between buildings or sections of the same property.

Where all the buildings are either brick and sprinklered, or of fire resistive construction there need be little fear of fire spreading from one section to another and it is not ordinarily essential to protect the window openings especially with metal working risks. It is evident that in case a building with extra hazardous processes, such as japanning, enameling, dry kilns, etc., is in close proximity to a main building, the latter should have shutters or wired glass windows on the exposed side. Also if foundries, forge shops or similar one-story buildings, adjoin a main building, the windows above the roof should be pro-

tected. Frame buildings are more susceptible to exposure fires and also form a more severe exposure to other buildings. Where brick buildings are exposed by frame the former should have shutters or wire glass windows on exposed side. Where frame buildings are exposed by brick or by each other they should have a standard system of open sprinklers consisting of one line at eaves and a line over each horizontal row of windows below the top. Brick buildings of three stories or less may generally be considered as not exposing each other when fifty feet or more apart, assuming that they are sprinklered and have hydrant protection. Frame buildings may expose each other materially if even 100 feet distant on account of height and area.

Where buildings are in sections with standard cut-offs, attention must be given to exposing windows, especially angle windows. Where the brick walls are at right angles with the cut-off wall at the angle it is generally desirable to protect all window openings for a distance of from thirty to fifty feet each way from the angle. The chance of fire lapping round a cut-off wall where the outside brick wall is straight is remote in this class of property. All problems of inter-exposure between buildings or sections should be referred to the underwriters having jurisdiction who will designate just what protection is necessary. Standard fire doors and shutters, also wired glass windows, should bear the label of the Underwriters' Laboratories to guarantee that they are made in conformity with the Rules and Regulations of the National Fire Protection Association. Open sprinklers should be installed in accordance with the Rules and Regulations of the National Fire Protection Association and the underwriters having jurisdiction should be consulted as to water supplies and other features.

Outside Exposure. It is generally conceded that any buildings within a hundred feet of the property may be classed as exposures and need to be given consideration. It is evident that in some cases buildings over a hundred feet may be of importance and in other cases buildings considerably less than a hundred feet may be unimportant because of their height, area or occupancy. It is best to be on the safe side and protect against all possible exposures. Where the exposure is not serious, as for instance a moderate sized building of ordinary occupancy over fifty feet distant, open sprinklers can be used to advantage and they are much less expensive than shutters or wired glass windows. With exposing buildings of three stories or over, of combustible occupancy and less than 50 feet distant, it is generally necessary to protect all wall openings with standard shutters or wired glass windows. The questions of outside exposure and protection should be in all cases referred to the underwriters having jurisdiction.

MANAGEMENT AND CARE OF FIRE APPLIANCES.

Good housekeeping and proper care of fire appliances are of prime importance and cannot be too strongly emphasized. Regardless of the hazards of occupancy a well kept factory will generally have few fires, while the poorly kept factory is in constant danger. Care of the common hazards has already been mentioned but may be repeated. Electric equipment should be maintained in full accordance with the National Electrical Code, this applying to all changes and additions.

Steam pipes should be kept clean and no combustible material allowed in contact with them. Shafting should be well oiled and bearings kept clean. Factory should be swept up daily and all rubbish and sweepings properly cared for. Oily waste should be picked up and kept in metal cans.

Most of these features are well understood but they are seldom given the attention they deserve and a large proportion of the factory fire loss can be attributed to the careless or slovenly manager or superintendent who may know how to produce goods at bottom cost but has no idea of good housekeeping.

The care of fire appliances is often sadly neglected and sprinkler systems or other fire extinguishing devices soon become of little value unless some attention is given to them.

A weekly written report should be made by some competent and reliable man and filed for reference. This to include all matters pertaining to fire protection as well as housekeeping. Sample blanks will be furnished by the underwriters having jurisdiction. In large plants it is advisable to have one man who spends all of his time on this work and makes a daily report of the conditions. Many a manufacturer little realizes the actual condition of his plant and inspections by the fire insurance companies show that dangerous conditions are common and many fire appliances are of no value due to lack of care on the part of the property owner.

SPECIAL CLASSES OF METAL WORKERS.

THE FOUNDRY OR CASTING SHOP.

Construction. This building should be detached or properly cut off from other buildings. Not over one story high and constructed entirely of non-combustible material. The floor is ordinarily dirt, walls brick, concrete or iron, and roof iron or concrete on steel girders. There should be no woodwork of any kind in the construction, either floor, walls or roof. Because of the fact that a foundry should contain practically no combustible material except the few patterns and flasks that are in use, it is not necessary to protect the metal work and a cheap serviceable building can be constructed of steel frame, brick curtain walls, steel truss roof with book tile or reinforced concrete covering.

Common Hazards. The various features of heat, light and power should receive the same treatment as the ordinary building except that if necessary coal stoves may be used without greatly increasing the hazard owing to the lack of combustible surroundings or contents.

Special Hazards. The cupola is a common cause of fire either due to sparks or excessive heat igniting roof, platform or other combustible material. It is very essential not to have combustible material near the cupola, and not only should the construction including floor, platforms and roof be non-combustible but care should be taken that no flasks, patterns, boards, etc., be even temporarily placed in that vicinity. The cupola platform can be constructed of iron or concrete, the latter perhaps affording a better footing for the workmen. Flasks that are

not in use should be stored in a detached shed preferably of non-combustible material. A cheap flask shed can be constructed of corrugated iron sides and a thin reinforced concrete roof. Flasks should not be stored in the foundry proper, but after using and before placing in the store shed they should be set aside to cool. Patterns should be stored in a fire resistive building constructed according to the National Building Code. They are usually of considerable value and being combustible in themselves they should never be kept in lightly constructed buildings.

Core ovens should be entirely of non-combustible material.

Inside Protection. If any portion of the building is of combustible material, walls, roof, floors, platforms, etc., there should be a standard equipment of automatic sprinklers. The pattern house and flask shed should be equipped regardless of the construction because of the combustible contents. There should be a standard supply of water pails and chemical extinguishers.

Outside Protection, Alarm Service and Exposure. The foundry, pattern house and flask shed should have similar treatment to the Manufacturing Metal Worker, this even with the non-combustible foundry as there are always some combustible contents such as flasks and patterns. If there is a serious exposure there should be no outside unprotected members.

THE FORGE SHOP.

This should be a detached or cut-off one-story building, and should be constructed and protected as noted for foundries. There is less objection however, to a wooden roof than with the foundry, and a mill constructed roof with automatic sprinklers may be considered satisfactory. Combustible walls or floors are very objectionable. The mufflers, furnaces or forges should be substantially constructed, and have good brick flues eight inches thick and lined. The ceiling if of wood should be at least fifteen to twenty feet above the furnaces. There should be no combustible material of any kind allowed in the forge shop either in the construction or contents with the possible exception of the roof.

MUFFLERS AND FURNACES.

Those buildings or portions of the plant where large or high temperature furnaces are used should be one story and constructed entirely of non-combustible material. The excessive heat makes a wooden roof undesirable and automatic sprinklers may be undesirable for the same reason. These portions can be made entirely safe through proper construction and keeping the building free from combustible material. No matter how well constructed, there is always a distinct hazard from the mufflers or furnaces if combustible material is present. Mufflers should be of substantial brick construction with brick flues.

Other features of protection should have similar treatment to the foundry.

ROLLING AND WIRE MILLS.

The casting shops and furnaces have been already mentioned. The rolling or wire mill proper should have brick or concrete walls

and a plank roof or steel truss with automatic sprinkler protection. Wood posts or girders are not desirable because of the hot metal. Steel roof members or columns do not need special protection. Floors should be non-combustible, concrete or brick being generally satisfactory. Other features of construction and protection should have the same treatment as the Manufacturing Metal Workers.

JAPANNING, PAINTING OR ENAMELING.

These processes are prolific of fires and need especial attention. Where only carried on in a small way, so that a single room of small size would suffice it may be satisfactory to have it in the main factory. In this case the room should have non-combustible floor, walls and ceiling, as already mentioned for small furnace rooms. Furthermore if dip tanks are used the floor should be arranged to drain and the door sill should be raised to prevent the inflammable liquid from running out into main factory.

Construction. Where these processes are carried on extensively, as is the case in many classes of metal workers, a detached building should be provided. This building to be of fire resistive construction, preferably not over two stories high, of small area or sub-divided by fire walls into rooms not over 2,500 square feet area. Floors to be protected to drain with overflow outside to a well of ample capacity. No openings between floors. Stairs and elevators to be in standard cut-off towers.

Common Hazards. Especial care must be taken with the lighting hazard because of the inflammable vapors. Only incandescent electric lamps should be used, double glass bulbs, keyless sockets, all cut-outs, switches, etc., being outside. (See National Electric Code.)

Special Hazards. Main supply of oils, japan, paints, turpentine, benzine, etc., to be kept in a detached fire-proof oil house. Keep as little as possible in the japanning room or building and that only in tightly covered metal cans.

Dip tanks to be of metal with overflow pipes and automatic covers as suggested by the National Fire Protection Association. (See special pamphlets.)

Ovens or dryers to be substantially constructed of non-combustible material, properly ventilated and heated by steam. Steam pipes to be at side and arranged so that oils are not liable to drop on them and to be kept clean.

Inside Protection. To have automatic sprinklers throughout. Water pails are of little value and there should be a liberal supply of sand pails and chemical extinguishers.

Outside Protection. Same as for Manufacturing Buildings.

Alarm Service. It is generally undesirable for watchman to visit the rooms where japanning or similar hazards exist and an automatic alarm system is advisable or dependence can be placed on the sprinkler alarm.

Exposure. If japan building is near other buildings all windows should be protected with wired glass, this being superior to shutters in that it is always in place, and it will confine the fire.

Management. Especial care is needed as regards cleanliness,

rules to prevent smoking, and use of other lights, and all employees should be made familiar with the hazard.

LACQUERING.

This hazard requires similar treatment to the japanning hazard. It is, however, often done in a small way where special protections are not so essential. Small open trays of lacquer are not especially objectionable if the immediate surroundings are non-combustible. A metal cover should be provided. Small lacquer dry boxes should be of metal and steam heated. No open lights should be used where lacquering is done.

Pyroxylin lacquers are very inflammable and the class of metal lacquers as a whole should be recognized as needing more than ordinary care, especially if used in large quantities, in which case it should be carried on in an especially constructed fire resistive building with similar safeguards to japanning.

WOODWORKING.

The woodworking hazards are treated in detail as a special class. Some of the more important may be mentioned here as being frequently found in metal workers making their own patterns. The woodworking processes should always be carried on in a separate detached building preferably of standard mill construction and equipped throughout with automatic sprinklers.

Dry Kilns. Lumber dry kilns should be detached, brick walls, plank or non-combustible roof, heated by steam or hot air, steam pipes to rest on iron with space underneath for cleaning. To be equipped with automatic sprinklers.

Shaving Vault. All woodworking machines to have an approved blower system for conveying waste to a fire-proof vault, detached or cut off from boiler room, vault to be sprinklered.

Dry Boxes. To be of metal, or of wood lined with asbestos and metal, heated by steam with pipes properly arranged.

Glue Pots. To be heated with steam.

HENRY A. FISKE.

Denatured Alcohol.

Present Status of Regulations, Special Formulas Now Prescribed and Industries Now Using Specially Denatured Alcohol.*

The impression seems to prevail in many parts of the country that there exist many restrictions, due to governmental regulation, that interfere to a greater or less extent with the handling of denatured alcohol This impression has no foundation in fact. While there is of necessity some detail, there are no restrictions that add one cent to the cost of handling denatured alcohol and no requirements that can not be met by any ordinary business man.

Permit to deal in denatured alcohol must be secured from the collector of internal revenue of the district in which the dealer does business. Any merchant can secure a permit, and there is no charge for same. The application need not be sworn to (except in certain cases), and a permit need not, as formerly, be renewed annually, but is good until it is surrendered, or, for cause, is canceled. Retail dealers in denatured alcohol are those who make single sales of less than five wine gallons. Such dealers are not required to keep any record whatever of the denatured alcohol received or sold by them. They are required simply to affix to each package sold a label indicating that the same contains denatured alcohol. Retail dealers in denatured alcohol may purchase completely denatured alcohol in any quantity desired either from denaturers or wholesale dealers without any restrictions whatever. Dealers in denatured alcohol may receive such alcohol either in the original stamped packages or in tanks, or they may receive it from transportation tanks (tank cars) or from delivery tanks (tank wagons), for storage in storage tanks on their premises, and they may sell either from stamped packages or from storage tanks.

Persons desiring to use denatured alcohol for the production of light, heat, or power may purchase in such quantities as suit their convenience. When purchasing in quantities of more than five gallons they may receive and keep the alcohol stored in stamped packages, or they may receive it from transportation or delivery tanks and keep it stored in consumers' tanks. In the latter case they must secure a permit from the collector of internal revenue authorizing them to so receive and store denatured alcohol.

Wholesale dealers in denatured alcohol are those who make single sales of five wine gallons or more. Such dealers are required to keep a record in which to enter the denatured alcohol received and disposed of in wholesale quantities. A monthly return must be rendered by each wholesale dealer, to be made up from this record. This is the only record and return required of dealers in denatured alcohol.

Collectors and revenue agents are instructed, as opportunities offer, to fully advise those in whose business alcohol can be used as to the rights and privileges of manufacturers using denatured alcohol in manufacturing processes.

* Gathered from correspondence of the Internal Revenue Department.

Denatured alcohol may, under the law, be employed in the manufacture of anything except beverages or liquid medicinal preparations and under the amendatory act of March 2, 1907, it may be employed in the manufacture of chloroform and ether. Regulations 30, revised, authorize the use of either completely or specially denatured alcohol in manufacturing processes. There are two formulas under which alcohol is denatured completely, to wit, the wood alcohol-benzine and the wood alcohol-pyradin formulas. Completely denatured alcohol is sold on the market without restrictions. Manufacturers using less than 50 gallons of completely denatured alcohol per month are not required to secure permit. Manufacturers using more than 50 gallons of such alcohol per month are required to secure permit from the collector of internal revenue of the district in which the business is located. No records are to be kept or returns made by manufacturers using completely denatured alcohol unless they recover alcohol for reuse. The manufacturer is simply required to keep the alcohol locked in a room or rooms anywhere on his premises, and he may keep it in any room on his premises except one in which distilled spirits, wine, or malt liquors are kept or stored. Completely denatured alcohol may be bought from dealers or denaturers in the open market, and may be delivered in either stamped packages, or by transportation tanks (tank cars), or delivery tanks (tank wagons). It may be kept on the manufacturing premises, stored in stamped packages, or in tanks specially set aside for that purpose

Where completely denatured alcohol is not suitable for use in an industry, and denatured alcohol, withdrawn from bond free of tax, can be legally used in such industry, the regulations provide for the authorization of the use of alcohol denatured under a special formula. Manufacturers using specially denatured alcohol must secure their alcohol direct from a denaturer—that is to say, either from a distillery or a central denaturing bonded warehouse. Manufacturers using specially denatured alcohol are required to provide a room in which to store the alcohol as it is received. They must also name a custodian, who is to have supervision over the room and the alcohol stored therein—that is, to carry the keys to the room or any tanks that may be located therein for the storage of alcohol. This room must be used exclusively for the storage of alcohol. Such manufacturers are permitted to receive alcohol in bulk from transportation or delivery tanks and to keep it stored in their storeroom in storage tanks.

Manufacturers using either completely or specially denatured alcohol are permitted to recover the alcohol used by them and to restore it to a condition suitable for reuse. This may be done either at their manufacturing plant under proper supervision, or it may be done at a bonded central restoring and redenaturing plant to which such recovered alcohol can be shipped and from which it can be received again for reuse.

Up to date, (April 1, 1908), the following formulas have been authorized for use in the following industries, to wit:

To 100 gallons of ethyl alcohol add—

No. 1. Five gallons of approved wood alcohol, the wood alcohol to be subject to the same specifications as are imposed upon the methyl alcohol used in completely denatured alcohol.

Industries. Shellac varnishes, photographic dry plates, embalming fluid, heliotropin, lacquers from soluble cotton, resin of podophyllum, and similar products, manufacture of thermometer and barometer tubes, manufacture of watches and jewelry, (formula No. 7 being revoked), confectioners' colors, surgical ligatures, filaments for incandescent electric lamps, silverware and bronze, mouldings and picture frames, shoe polish, ethyl chloride, solid and powdered medicinal extracts, acetic ether (provided that the finished product contains not more than 6% of alcohol by volume), and as an alternative in the manufacture of transparent soap.

No. 2. Seven pounds of camphor and five gallons of commercially pure methyl alcohol, the methyl alcohol to have a specific gravity of not more than 0.810 at 60° F.

No. 2 (a). (Alternative). Two gallons of approved wood alcohol and two gallons of benzol. The wood alcohol shall be subject to the same specifications as are imposed upon the wood alcohol used in completely denatured alcohol and the benzol shall be subject to the specifications given in a previous article.

Industries. Manufacture of celluloid, pyralin, and similar products.

No. 3. Six and one-half gallons of the following mixture:

Five gallons of commercially pure methyl alcohol, having a specific gravity of not more than 0.810 at 60° F.; one gallon of castor oil; one-half gallon of 36° Beaume' caustic soda lye. The denaturing mixture is best prepared by dissolving the castor oil in the methyl alcohol, and then adding the soda lye.

No. 3 (a). (Alternative). Formula No. 1.

Industry. Transparent soap.

No. 4. One gallon of the following solution: Ten gallons of an aqueous solution containing 40% nicotine; 0.4 pound acid, yellow dye (fast yellow); 0.4 pound tetrazo brilliant blue, 12 B. Conct.; water to make 100 gallons. The tobacco denaturant must conform to certain analytical requirements, not necessary to give here. (This formula applies to rum or alcohol.)

Industry. Manufacture of smoking and chewing tobacco.

No. 5. Sixty-five pounds of sulphuric ether, three pounds of cadmium iodide, and three pounds of ammonium iodide.

Industries. Manufacture of photo engravings, photo enlargements and photo prints.

No. 6. Three gallons commercially pure methyl alcohol and one half gallon pyridin bases; the methyl alcohol to have a specific gravity of not more than 0.810 at 60°F; the pyridin bases to confrom to specifications as imposed upon it for use in completely denatured alcohol.

No. 6 (a). (Alternative.) Restricted to factories operating in connection with either a distillery or a central denaturing bonded warehouse.

Fifteen gallons of condensed fumes of fulminate of mercury recovered in the process of manufacture. The condensed liquid shall be subject to the following specifications. It must contain not less than 4 grams per 100 cubic centimeters of mixed aldehydes calculated as acetic aldehyde.

Industry. Manufacture of fulminate of mercury.

No. 8. One gallon of approved pyridin bases and one gallon of approved benzol.

Industry. Manufacture of sulphonmethane.

No. 9. Ten gallons of acetone and two gallons of petroleum naphtha. The petroleum naphtha to have a specific gravity of not less than 0.650 nor more than 0.720 at 60° F.

Industries. Purification of rubber and manufacture of tannic acid.

No. 10. Two gallons of approved wood alcohol and two gallons of approved benzol.

Industry. Manufacture of pastes and varnishes from soluble cotton.

No. 11. One hundred pounds of sulphuric ether and 10 pounds of cadmium iodide.

No. 11 (a). (Alternative.) Formula No. 5.

Industry. Manufacture of photographic collodion.

No. 12. One gallon of approved pyridin bases and two gallons of approved coal tar benzol.

Industry. Manufacture of imitation leather products.

No. 13. Five gallons of sulphuric acid having a specific gravity of not less than 1.83 at 60° F. and five gallons of sulphuric ether having a specific gravity of not more than .728 at 60° F.

No. 13 (a). (Alternative.) Ten gallons of sulphuric ether, having a specific gravity of not more than .728 at 60° F.

Industry. Manufacture of sulphuric ether. (The alternative formula is only allowed for the manufacture of sulphuric ether containing not more than .4% of alcohol by weight. This is not as efficient a denaturing material and a careful and close surveillance of factories using it must be maintained.)

No. 14. Five gallons commercially pure methyl alcohol and 10 pounds anhydrous zinc chloride.

Industry. Ethyl chloride for anesthesia.

No. 15. Three gallons of sulphuric acid having a specific gravity of not less than 1.83 at 60° F., and one gallon of kerosene having a specific gravity of not less than .800 at 60° F.

Industry. Manufacture of nitrous ether.

J. ALBERT ROBINSON, *Inspector,*
The Underwriters' Bureau of New England.

Secretary's Report, Branch Offices, and Underwriters' Laboratories.

The Twelfth Annual Meeting of the Association will be held at Chicago, Tuesday, Wednesday and Thursday, May 26th, 27th and 28th.

In addition to the usual attractive program covering important Committee reports and papers on interesting topics, some portion of the third day will be devoted to visit to the Underwriters' Laboratories to afford members an opportunity to become acquainted with the most recent test methods and developments in the work of that institution.

The complete program will be mailed members as usual in advance of the meeting.

It is unlikely that any special reductions in railway rates can be secured for members, but some of the roads will very likely have low rates, especially from eastern points, in force at the time.

No one hotel has been selected as headquarters. The Auditorium Annex, on Michigan Avenue, is generally considered as good as any in Chicago. The Stratford, the Grand Pacific and the Great Northern are also generally considered satisfactory. Members desiring to reserve accommodations in advance should write direct to the hotel. Rates for single rooms are from $2.00 to $4.00 per day.

The attendance of all members at the annual meeting is urgently requested.

By vote of the Executive Committee, the maintenance of special offices of the Association in the Engineering Societies Building, 29 West 39th Street, New York, has been discontinued. We are assured that the assembly and committee rooms in the building will be available for our use as formerly.

The resignation of Mr. Hugh T. Wreaks, as Assistant Secretary in charge of the New York office, has been accepted.

By vote of the Executive Committee, advance copies of Committee reports and papers for the Annual meeting will not be printed separately and distributed to members as formerly. Much of this matter will, however, be found in this issue of the Quarterly.

The following suggestion for change in the Articles of Association has received the endorsement of the Executive Committee:

Article 2 to be changed to read:

"The objects of this Association shall be to promote the science and improve the methods of fire protection *and prevention;* to obtain and circulate information on *these subjects,* and to secure the cooperation of its members in establishing proper safeguards against loss of life and property by fire."

The changes desired are given in italics.

APPROVED DEVICES AND MATERIALS.

By direction of the Executive Committee (action November, 1907) we list below in form convenient for reference by members the names and addresses of manufacturers of devices and materials which have thus far been favorably passed upon by the Committee of Devices and Materials, following examinations, tests and recommendations made by Underwriters' Laboratories, Inc.

The Laboratories have also issued reports giving ratings unfavorable to a large number of appliances. A summary of the findings in each case can be obtained by addressing the Laboratories and any Active or Associate member can receive regularly the cards issued by the Laboratories giving summaries of the results obtained in the current work in all of its departments upon payment of the subscription price of fifteen dollars ($15) per year.

In the lists which follow members should note particularly that in those industries to which the label service has been extended (indicating inspection of goods by Laboratories' engineers at factories before shipment), that **only such of the product of these factories as bear the labels referred to** are covered by the endorsement of our Committee.

BUILDING MATERIAL.

Post Cap and Girder Support (Steel and Malleable Iron).

Caps inspected at factory bear labels attached to an exposed side reading as follows:

The following company is equipped to supply these devices. Members are advised to give preference to devices which bear the label referred to.

Chicago, A. M. Castle & Co., 55 N. Jefferson Street.

CARBONIC ACID GAS HAND FIRE EXTINGUISHERS.

Carbonic Acid Gas Hand Fire Extinguishers constructed in accordance with National Fire Protection Association specifications and examined and tested at factories under the supervision of Underwriters' Laboratories, Inc., have metal labels soldered to the front of the cylinders reading:

The following companies are equipped to supply these devices. Members are advised to give preference to extinguishers which bear the labels referred to.

Boston, Badger Fire Extinguisher Co., 32 Portland Street.
Boston, Knight & Thomas, 99 State Street.
Buffalo, Western Inspection Co., 45 N. Division Street.
Chicago, Miller Chemical Engine Co., 149 E. Huron Street.
Cincinnati, Harker Mfg. Co., 118 W. Second Street.
Columbus, Seagrave Company, South High Street.
Elmira, N. Y., American-LaFrance Fire Engine Co., Elmira.
Newark, N. J., The Tea Tray Company of Newark, N. J., Mulberry and Murray Streets.
Philadelphia, James Boyd & Bro., 14 North Fourth Street.
Philadelphia, National Inspection Co., 418-422 Sansom Street.
Pittsburg, Fire Extinguisher & Supply Co., 1414-1422 Spring Garden Avenue, N. S.
Pittsburg, Pittsburg Lamp, Brass & Glass Co., Pittsburg.
St. Louis, Frank & St. Gemme Mfg. Co., 815-817 Market Street.
St. Louis, Missouri Lamp and Mfg. Co., 116 Elm Street.
St. Louis, Stempel Fire Extinguisher Co., 4250 North 20th Street.
Toronto, Canada. Victor Fire Extinguisher Company, 704 Continental Life Building.
Utica, O. J. Childs Co., 50 Liberty Street.

CARBONIC ACID GAS FIRE EXTINGUISHERS, 40 Gallon.

Carbonic Acid Gas Fire Extinguishers of 40 gallon capacity mounted on wheels, constructed in accordance with the latest specifications and examined and tested at factories under the supervision of Underwriters' Laboratories, Inc., have labels soldered to the front of the cylinder reading as follows:

The following company is equipped to supply these devices:

Boston, Badger Fire Extinguisher Co., 32 Portland Street.

DOORS.

N. F. P. A. Standard 2½ inch metal clad.

Doors of this class constructed in accordance with National Fire Protection Association specifications and examined and tested at factories under the supervision of Underwriters' Laboratories, Inc., are labeled by stampings in the tin plates or by attaching brass labels reading:

The following companies are equipped to supply these devices. Members are advised to give preference to doors which bear labels referred to.

Cleveland, O'Donnell Safety System Co., 3062 Superior Avenue, N. E.
Cleveland, Riester & Thesmacher Co., 325-329 Pearl Street.
Newburyport, Victor Manufacturing Co.
New Orleans, American Sheet Metal Works, Carrollton Avenue and Edinburg Street.
New Orleans, A. J. Nelson Manufacturing Co., Ltd.
New Orleans, New Orleans Roofing and Metal Works.
New York, Howell & Lawrence, 1788 First Avenue.
New York, John W. Rapp, 1 Madison Avenue.
St. Louis, Mesker & Bro., 421-519 S. Sixth Street.

Door and Shutter, Metal.

Doors of this class which are considered to be the equivalent of the N. F. P. A. Standard 2½ inch metal clad door for openings not exceeding 72 inches in width and examined and tested at factories under the supervision of Underwriters' Laboratories, Inc., have labels riveted to the door reading as follows:

(*See label under N. F. P. A. Standard 2½ inch metal clad door.*)

The following company is equipped to supply these devices. Members are advised to give preference to doors which bear label referred to.

Memphis, Tenn., Saino Fire Door and Shutter Co., 538 Lucy Avenue.

Corridor or Partition Doors. (Not for openings in fire walls.)

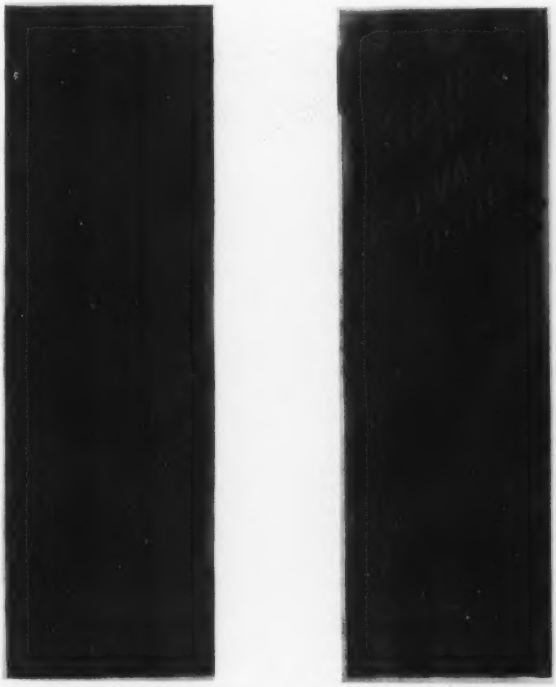
Doors of this class constructed in accordance with National Fire Protection Association specifications and examined and tested at factories under the supervision of Underwriters' Laboratories, Inc., have labels screwed or riveted to the edge of the door reading: (See cut.)

The following companies are equipped to supply these devices. Members are advised to give preference to doors which bear the labels referred to.

Chicago, Knisely Bros., Fifth Avenue and 28th Place.
Chicago, Voigtmann & Co., 42-54 East Erie Street.
Jamestown, N. Y., Dahlstrom Metallic Door Co., Jamestown.
Minneapolis, Minn., Northwestern Roofing, Cornice and Stamping Works, 113 S. Fifth Street.
Minneapolis, Minn. Thorp Fireproof Door Co., 1600-1616 Central Avenue.
New York, Howell & Lawrence, 1788 First Avenue.
New York, Manhattan Fire Proof Door Co., 412-422 E. 125th Street.
New York, J. F. Blanchard Co., Fuller Bldg.

Stair or Elevator Doors. (Not for openings in fire walls.)

Doors of this class constructed in accordance with National Fire Protection Association specifications and examined and tested at factories under the supervision of Underwriters' Laboratories, Inc., have labels screwed or riveted to the edge of the door reading: (See cut.)



The following companies are equipped to supply these devices. Members are advised to give preference to doors which bear labels referred to.

Jamestown, N. Y., Dahlstrom Metallic Door Co., Jamestown.
Minneapolis, Minn., Northwestern Roofing, Cornice and Stamping Works, 1113 S. Fifth Street.
Minneapolis, Minn., Thorp Fireproof Door Co., 1600-1616 Central Avenue.
New York, J. F. Blanchard Co., Fuller Bldg.
New York, Howell & Lawrence, 1788 First Avenue.
New York, Manhattan Fire Proof Door Co., 412-422 E. 125th Street.

DOOR AND SHUTTER HARDWARE.

3½ x ⅜ Hardware for Sliding Doors only.

Hardware of this class constructed in accordance with National Fire Protection Association specifications and examined and tested at factories under the supervision of Underwriters' Laboratories, Inc., have labels attached to each hanger, binder and stay roll of each set reading:

A tag is also attached to one hanger of each set on which is printed a list of the pieces which a complete set should contain, as follows:

1. **One 3½x⅜ inch track, length to be equal to twice the width of door opening plus 21 inches. Punched for wall bolts.**
2. **Two hangers for openings 6 feet and less in width, three hangers for openings wider than 6 feet. Bolts for attaching hangers to door.**
3. **Two 3½x⅜ inch binders.**
4. **One 2x½ inch stay roll.**

Stay roll should be the type specified for the form of sill used, and should include all bolts except wall bolts.

5. **One cast iron bracket for each track bolt.**
6. **Two ¾x¼ inch half oval chafing strips for back of door, two 1x⅛ inch flat strips for front of door opposite the oval strips. Bolts for fastening above strips together through door. Length of above strips to be 4 inches less than door opening.**
7. **One 1½x⅛ inch strip 5 inches less than width of door to take wear of stay roll. Wood screws for attaching.**
8. **One wedge with screws for attaching.**
9. **One bow shaped handle and one flush pull with bolts and screws for attaching.**
10. **One front bumper and one back bumper.**
11. **Four bumper shoes and screws for attaching.**
12. **One washer for each wall bolt, including those for binders and stay roll.**
13. **One instruction card for mounting.**

Where the hardware for a single fire door on each side of the fire wall is bolted together through the wall, the washers above specified are unnecessary.

Wall bolts are not included as the requirements for length varies in each case. Automatic attachments are not as yet included in a standard set of hardware.

The following companies are equipped to supply these devices. Members are advised to give preference to hardware which bears the labels referred to.

Aurora, Ill., Richard Mfg. Co., Aurora.
Aurora, Ill., Wilcox Mfg. Co., Aurora.
Philadelphia, James Peters & Sons, 1934-38 North Front Street.
Newburyport, Mass., Victor Manufacturing Co.

Specially Designed, Malleable Iron Hardware for Sliding Door Only.

Hardware of this type which is considered to be the full equivalent of the 3½ x ⅜ hardware made in accordance with National Fire Protection Association specifications, and examined and tested at factories under the supervision of Underwriters' Laboratories, Inc., have labels attached to each hanger, binder and stay roll of each set reading:

(*See label under hardware for sliding doors.*)

A tag is also attached to one hanger of each set on which is printed a list of the pieces which a complete set should contain, as follows:

1. **One 1 7-16 inch tubular track, length to be equal to twice the width of the door opening, plus 14 inches.**
2. **Two hangers for openings six feet and less in width; three hangers for openings wider than six feet. Bolts for attaching hangers to door.**
3. **Two malleable iron binders.**
4. **One malleable iron stay roll.**
5. **Brackets to carry track, including two special end supports.**
6. **Two ¾x¼ inch half oval chafing strips for back of door, two flat strips for front of door opposite the oval strips. Bolts for fastening above strips together through the door. Length of above strips to be 4 inches less than door opening.**
7. **One 2¼x⅛ inch strip 5 inches less than width of door to take wear of stay roll. Wood screws for attaching.**
8. **One steel wedge with screws for attaching.**
9. **One bow shaped handle and one flush pull with bolts for attaching.**
10. **One front bumper and one back bumper.**
11. **Four bumper shoes and screws for attaching.**
12. **One washer for each wall bolt, including those for binders, bumpers and stay roll.**

Where the hardware for a single fire door on each side of the fire wall is bolted together through the wall, the washers above specified are unnecessary.

Wall bolts are not included as the requirements for length vary in each case. Automatic attachments are not as yet included in a standard set of hardware.

UNDERWRITERS' LABORATORIES, Inc.,
382 Ohio St., Chicago.

The following company is equipped to supply these devices. Members are advised to give preference to hardware which bears the labels referred to.

Chicago, Allith Manufacturing Co., Taylor Street and 43rd Avenue.

FIRE DOORS. (See Doors.)

GLASS. (See Wired Glass.)

HARDWARE. (See Door and Shutter, Hardware.)

HEAT INSULATING COVERINGS.

The following material is approved for heat insulating purposes for walls, floors and ceilings in cold storage warehouses, cold storage cellars in breweries, cold rooms in packing houses, hotel refrigerators, fur storage rooms and rooms of this character.

Cork Board (Nonpareil) laid in cement mortar. Manufactured by Armstrong Cork Co., Pittsburg, Pa.

HOSE.

2½ Inch Cotton Rubber-Lined.

Private Department Fire Hose for outside use constructed in accordance with National Fire Protection Association specifications and examined and tested at factories under the supervision of Underwriters' Laboratories, Inc., have attached to each 50 foot length label reading:

The following companies are equipped to supply this material. Members are advised to give preference to hose which bears label referred to.

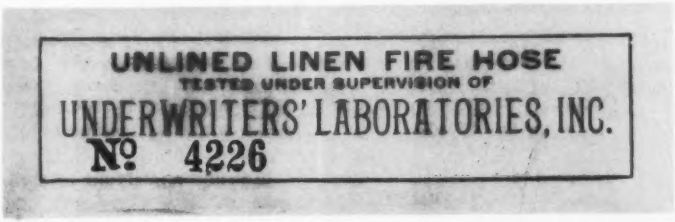
Akron, O., B. F. Goodrich Co., Akron.
Boston, Boston Woven Hose and Rubber Co., P. O. Box 5077.
New York, Eureka Fire Hose Co., 13 Barclay Street.
New York, Manhattan Rubber Mfg. Co., 18 Vesey Street.
New York, New York Belting and Packing Co., Ltd., 91 Chambers Street.
New York, Fabric Fire Hose Co., Corner Duane and Church Streets, Elkshead.

Before the extension of the label service to this industry approvals were granted to certain brands of hose manufactured by the foregoing and other companies as follows:

American, Boston Belting Co., 256 Devonshire Street, Boston, Mass.
G. P. Gutta Percha and Rubber Mfg. Co., 126 Duane Street, New York.
Guttaperch, Gutta Percha and Rubber Mfg. Co. of Toronto, Ltd., 47 Yonge Street, Toronto, Ont.
Security, Revere Rubber Co., Chelsea, Mass.
Star, Canadian Rubber Co., Notre Dame Street and Papineau Avenue, Toronto, Ont.
Tuebor, New Jersey Car Spring and Rubber Co., Wayne and Brunswick Streets, Jersey City, N. J.
2-X-L, Mechanical Rubber Co., Cleveland, O.

HOSE, Unlined Linen.

Unlined Linen Fire Hose for use inside buildings constructed in accordance with National Fire Protection Association specifications and examined and tested at factories under the supervision of Underwriters' Laboratories, Inc., has attached to each length label reading:



The following company is equipped to supply this material. Members are advised to give preference to hose which bears the label referred to.

New York. Eureka Fire Hose Co., 13 Barclay Street.

HYDRANTS.

The following hydrant has been examined and tested and pending the adoption of revised specifications for construction of devices of this class is recommended for use in connection with mill yard and other private underground fire mains. Service record generally satisfactory.

Indian Orchard, Mass. Chapman Valve Mfg. Co.

PAINTS, FIRE RETARDANT.

The so-called "cold water" paints listed below have been examined and tested.

These coatings for wood and other similarly combustible building materials which come under this class, or property so coated, should in

no sense be considered as "fire-proof." Their use is preferable to leaving the material uncoated because they retard the spread of fire over combustible surfaces and are particularly desirable in lieu of varnish, shellac, or oil finish, which latter serve to rapidly spread fire. Attention is called, however, to the need of renewal of the coatings in order to maintain the desired conditions.

Whitewash so well meets the requirements of this class that we print formula recommended by the Lighthouse Board of the United States Treasury Department as follows:

"Slake one-half bushel of unslaked lime with boiling water, keeping it covered during the process; strain it and add a peck of salt dissolved in warm water; three pounds of ground rice, put in boiling water and boil to a thin paste; one-half pound powdered Spanish whiting and a pound of clear glue dissolved in hot water; mix these well together and let the mixture stand for several days. Keep the wash thus prepared in a kettle or portable furnace, and when used put it on as hot as possible with painter's or whitewash brushes."

Where possible the coatings should be applied by a hand brush rather than by a spraying machine, thus effecting a better surface, and special care should be exercised not to coat sprinkler heads where installed.

Asbestine. Manufactured by The Muralo Co., New Brighton, S. I., N. Y.
Carey's. Manufactured by The Neptune Paint Co., Hudson, Mich., for The Philip Carey Mfg. Co., Cincinnati, O.
Decorine. Manufactured by Benj. Moore & Co., 111 N. Green Street, Chicago.
Hygienic Fireproof Calcimine. Manufactured by The Rubber Paint Co., 154 W. Van Buren Street, Chicago.
Indeliblo. Manufactured by The Muralo Co., New Brighton, S. I., N. Y.
Indurine. Manufactured by The Muralo Co., New Brighton, S. I., N. Y.
J. M. Manufactured by The Neptune Paint Co., Hudson, Mich., for H. W. Johns-Manville Co., Milwaukee, Wis.
Kimaco. Manufactured by The Muralo Co., New Brighton, S. I., N. Y., for Kimbark-McCarthy Co., Chicago.
K'Sene. Manufactured by The Muralo Co., New Brighton, S. I., N. Y., for Western Roofing and Supply Co., Chicago.
Lythite. Manufactured by The Muralo Co., New Brighton, S. I., N. Y.
Magnite. Manufactured by The Muralo Co., New Brighton, S. I., N. Y., for J. A. & W. Bird & Co., Boston.
Monarch. Manufactured by Geo. Fletcher & Co., 49-51 N. Ashland Avenue, Chicago.
Nepolite. Manufactured by The Neptune Paint Co., Hudson, Mich.
Retardo. Manufactured by Benj. Moore & Co., Chicago, for Retardo Fire Proof Paint Co., Milwaukee, Wis.
Stay-There. Manufactured by The Neptune Paint Co., Hudson, Mich., for The Hardie Mfg. Co., Hudson, Mich.

ROOFINGS.

Certain proprietary roofings listed below have been examined and tested.

These tests indicate that the fire retardant properties of these materials are inferior to those of slate, metal or good tin-clad roofs, but in a class with those of good slag and good gravel roofs, and superior to those of wooden shingle roofs.

Amazon Ready Roofing, (Prepared, 2 and 3 ply), Barrett Mfg. Co., Philadelphia, Pa.

Carey's Standard Magnesia Flexible Cement (Prepared), The Philip Carey Mfg. Co., Lockland, Cincinnati, O.

Carbonite (Prepared, 2 and 3 ply), The Heppes Co., 2427 Fillmore Street, Chicago.

Congo (Prepared, 2 and 3 ply), The Buchanan-Foster Co., 504 West End Trust Bldg., Philadelphia, Pa.

Eclipse Rubber (Prepared), Ford Manufacturing Co., Washington and Desplaines Streets, Chicago, Ill.

Ehrets (Slag), Warren-Ehret Co., 1202 Land Title Bldg., Philadelphia.

Elaborated Ready (Prepared), Elaborated Ready Roofing Co., 4419 La Salle Street, Chicago.

Flexo (Prepared, 2 and 3 ply), The Heppes Co., 2427 Fillmore Street, Chicago.

Galvanized Rubber (Prepared), Ford Manufacturing Co., Washington and Desplaines Streets, Chicago, Ill.

Genasco Asphalt Composition (4 ply), Barber Asphalt Paving Co., 1243 Stock Exchange Bldg., Chicago.

Genasco (Prepared Smooth Surface, 2 and 3 ply, Stone Surface, Whitestone and Model, 2 ply), The Barber Asphalt Paving Co., 1243 Stock Exchange Bldg., Chicago.

Granite (Prepared), The Eastern Granite Roofing Co., 1 Hudson Street, New York, N. Y.

Huttig Rubber (Prepared, 2 and 3 ply), Barber Asphalt Paving Co., 1243 Stock Exchange Bldg., Chicago, for Huttig Mfg. Co., Muscatine, Iowa.

Indruroid (Prepared, 2 and 3 ply), H. F. Watson Co., Erie, Pa.

Malthoid (Prepared, 2 and 3 ply), The Paraffine Paint Co., Merchants Exchange Bldg.

Mastic (Prepared), National Mastic Roofing Co., San Francisco, and National Roofings and Materials Co., Edwardsville, Ill.

Mikado (Prepared, 2 and 3 ply), J. A. & W. Bird & Co., 35 India Street, Boston.

No-Tar (Prepared, 2 and 3 ply), The Heppes Co., 2427 Fillmore Street, Chicago.

Paroid (Prepared, 2 and 3 ply), F. W. Bird & Son, East Walpole, Mass.

Protection Brand Asphalt Ready Roofing (Prepared), Asphalt Ready Roofing Co., 136 Water Street, New York.

Rex Flintkote (Prepared, 2 and 3 ply), J. A. & W. Bird & Co., 35 India Street, Boston.

Rhinoceros (Prepared, 2 and 3 ply), Warren Chemical and Manufacturing Co., 17 Battery Place, New York.

Roofrite (Prepared), The Lehon Co., W. 43rd Street, Lincoln to Robey, Chicago.

Rubber (Prepared, 2 and 3 ply), The General Roofing Co., East St. Louis, Ill.
Rubbertex (Prepared, 2 and 3 ply), The Heppes Co., 2427 Fillmore Street, Chicago.
Ruberoid (Prepared, 2 and 3 ply), Standard Paint Co., 100 William Street, New York.
Safety (Prepared), National Roofing Co., Tonawanda, N. Y.
Security (Prepared), National Roofing Co., Tonawanda, N. Y.
Standard Asbestos (Prepared), H. W. Johns-Manville Co., 100 William Street, New York.
Vulcanite (Prepared 2 and 3 ply), The Patent Vulcanite Roofing Co., 625 S. Campbell Avenue, Chicago.
Walrus (Prepared, 2 and 3 ply), Warren Chemical and Manufacturing Co., 17 Battery Place, New York.
West Coast Ready Rock (Prepared), The West Coast Company, Waukegan, Ill.

SHUTTERS. (See Doors.)

SPRINKLERS, Automatic.

It has not been judged necessary as yet to extend label service to these devices.

The following patterns are approved:

Grinnell Improved 1903. General Fire Extinguisher Co., Providence, R. I.
International, Evans 1902 Model. International Sprinkler Co., 517 Arch Street, Philadelphia, Pa.
Manufacturers "C". Manufacturers' Automatic Sprinkler Co., 48-50 Liberty Street, New York.
Neracher Improved 1902. General Fire Extinguisher Co., Providence, R. I.
Niagara-Hibbard, issue B, 1904. Niagara Fire Extinguisher Co., Akron, O.
Phoenix, issue A, 1905. Phoenix Fire Extinguisher Co., 1028-33 First National Bank Bldg., Chicago.
Rockwood, issue A. Worcester Fire Extinguisher Co., 4 Arch Street, Worcester, Mass.

SPRINKLER SUPERVISORY DEVICES.

For use in connection with approved central station systems.

Consists of apparatus for transmitting signals when gate valves are closed or opened; when water in tanks falls below or is restored to predetermined level; when pressure in air tanks falls below or is restored to predetermined amount; when water in tanks falls below or rises above predetermined temperatures. Also apparatus for connection with water flow valves to transmit water flow signals (where there is a flow of water equal to that of one or more sprinklers) and to withhold signals from water surges or variable pressure.

A. D. T. Devices for attaching to Central Station Signaling Systems for supervisory maintenance and operation of sprinkler equipments. Manufactured by Automatic Fire Protection Company, New York and Chicago.

VALVES, ALARM. (See also Sprinkler Supervisory Devices.)

No appliances meeting all of the requirements desirable for this service have as yet been shown.

Ratings covering the patterns found in common use have been issued as follows:

Evans Variable Pressure 1902 model. Manufactured by International Sprinkler Co., 517 Arch Street, Philadelphia. Not standard. Field experience limited, but fairly satisfactory where device has been properly installed, correctly adjusted and intelligently supervised.

Grinnell English Pattern, Variable Pressure (Swing check or Straightway type). Manufactured by General Fire Extinguisher Co., Providence, R. I. Not standard. Field experience fairly satisfactory where device has been properly installed, correctly adjusted and intelligently supervised.

Grinnell branch (old type called Harkness Tee). Manufactured by General Fire Extinguisher Co., Providence, R. I. Not standard. Field experience, where central station and Local Board supervision obtains and valves are under constant pressure, reported as fairly satisfactory.

Manufacturers'. Manufactured by Manufacturers Automatic Sprinkler Co., 48-50 Liberty Street, New York. Not standard. Field experience with an improved type of this valve in one locality, where central station and Local Board supervision obtains and valves are under constant pressure, reported as fairly satisfactory.

Niagara. Manufactured by Niagara Fire Extinguisher Co., Akron, O. Not standard. Field experience with an improved type of this valve in one locality, where central station and Local Board supervision obtains and valves are under constant pressure, reported as fairly satisfactory.

VALVES, DRY PIPE.

Following the continued effort of the Committee on Devices and Materials to secure improvements in this class of device manufacturers have improved patterns in process of construction, which when ready for the market may be distinguished by labels reading:

APPROVED DRY PIPE VALVE

No. 123456,

UNDERWRITERS' LABORATORIES, INC.

The following companies have shown plans or models, or both, for such valves:

Ashton Valve Co., 271 Franklin Street, Boston, Mass.
General Fire Extinguisher Co., Providence, R. I.
International Sprinkler Co., 517 Arch Street, Philadelphia, Pa.
Manufacturers' Automatic Sprinkler Co., 48-50 Liberty Street, New York.
Niagara Fire Extinguisher Co., Akron, Ohio.
Phoenix Fire Extinguisher Co., 1028 1st Nat'l. Bank Bldg., Chicago.
Worcester Fire Extinguisher Co., Worcester, Mass.

The older forms of these devices formerly approved were:
Grinnell. General Fire Extinguisher Co., Providence, R. I.
Grinnell Straightway. General Fire Extinguisher Co., Providence, R. I.
International (No. 2 Evans Model). International Sprinkler Co., Philadelphia.
Manufacturers. Manufacturers' Automatic Sprinkler Co., 48-50 Liberty Street, New York.

WATCHMEN'S TIME RECORDING APPARATUS.

Boxes for Central Station Systems.

Combined watchmen's Call and Fire Alarm Boxes for use in connection with approved normally closed circuit Central Station Watchmen's Time Recording Apparatus, constructed in accordance with National Fire Protection Association specifications and examined and tested at factories under the supervision of Underwriters' Laboratories, Inc., have labels fixed to the outside of clock cases reading:

The following companies are equipped to supply these devices:
American District Telegraph Co., 195 Broadway, New York.
Chicago Electric Protective Co., 147 Fifth Avenue, Chicago.
Signalphone Co., Milwaukee, Wis.

Before the extension of the label service to this industry approvals were granted to certain boxes manufactured by the foregoing and one other company as follows:
Viaduct Mfg. Co., 10 S. Howard Street, Baltimore, Md.

Apparatus for Local or Private Systems.

Watchman's Stationary Clocks constructed in accordance with National Fire Protection Association specifications and examined and tested at factories under the supervision of the Underwriters' Laboratories, Inc., have label fixed to the outside of clock cases reading:

and a decalcomania transfer is applied to the outside of the magneto cases reading:

The following companies are equipped to supply these devices:

American Watchman's Time Detectors Co., 2069 Fourth Street, Cleveland, O.
American Watchman's Time Detectors Co., 234-5 Broadway, New York.
Eco Magneto Clock Co., 289 Congress Street, Boston.
E. A. Hamilton & Co., Grand Rapids, Mich.
Holtzer-Cabot Electric Co., Brookline, Boston, Mass.
E. Howard Clock Co., 373 Washington Street, Boston, Mass.
Newman Clock Co., (Single Station Clock), Masonic Temple, Chicago.
Simplex Time Recorder Co., Gardner, Mass.

Before the extension of the label service to this industry approvals were granted to certain clocks manufactured by the foregoing and other companies as follows:

Indianapolis Magneto. Indianapolis Watchman Clock Co., Indianapolis, Ind.
Wakeman's Single Station. Wakeman's Time Recorder Co., Scranton, Pa.

Portable Clocks.

Watchman's Portable Clocks constructed in accordance with National Fire Protection Association specifications and examined and tested at factories under the supervision of Underwriters' Laboratories, Inc., have labels fixed to the inside of clock cases reading:

(*See cut under Local or Private Systems.*)

and a decalcomania transfer is applied to outside of the key boxes reading:

(*See cut under Local or Private Systems.*)

The following companies are equipped to supply these devices:

Eco Magneto Clock Co., 289 Congress Street, Boston.
Hardinge Bros., 1034-1036 Lincoln Avenue, Chicago.
E. O. Hausburg, 45 Maiden Lane, New York.
Nanz & Co., 127 Duane Street, New York.
Newman Clock Co., Masonic Temple, Chicago.
The Timekeeper Co., Chicago.

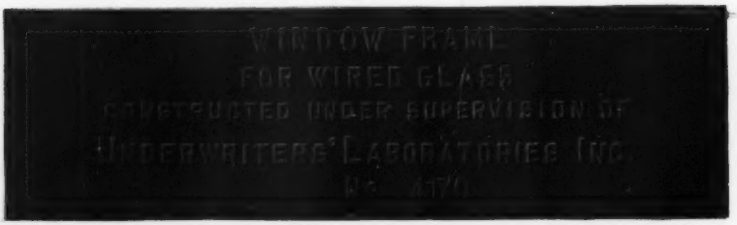
Before the extension of the label service to this industry approvals

were granted to certain clocks manufactured by the foregoing and one other company as follows:

New York. Manufactured by J. Schlenker, Germany, for The General Watchman's Time Detectors Co., New York.

WINDOWS.

Metallic Window Frames and Sash glazed with Wired Glass, constructed in accordance with National Fire Protection Association specifications and examined and tested at factories under the supervision of Underwriters' Laboratories, Inc., have labels riveted to the inside of the window reading:



The following companies are equipped to supply these devices. Members are advised to give preference to windows which bear the labels referred to.

Boston, E. B. Badger & Sons Co., 63 Pitts Street. Double Hung.

Brooklyn, Herrmann & Grace, 671-685 Bergen Street. Pivoted Upper Sash.

Chicago, Grace Cornice Works, 1260 Indiana Avenue. Double Hung.

Chicago, Harry C. Knisely Co., 273 S. Canal Street. Double Hung, Pivoted Upper Sash.

Chicago, Knisely Bros., Fifth Avenue and 28th Place. Casement, Double Hung, Pivoted Upper Sash.

Chicago, J. C. McFarland & Co., 27th Street and Fifth Avenue. Double Hung, Pivoted Upper Sash.

Chicago, Jas. A. Miller & Bro., 129 S. Clinton Street. Double Hung, Pivoted Upper Sash.

Chicago, Perkinson & Brown, 111 N. Lincoln Street. Pivoted Upper Sash.

Chicago, E. A. Rysdon & Co., 627-629 W. 41st Street. Double Hung, Pivoted Upper Sash.

Chicago, Sykes Steel Roofing Company, 112-120 W. 19th Place. Double Hung, Pivoted Upper Sash.

Chicago, Voigtmann & Co., 42-54 E. Erie Street. Double Hung, Pivoted Upper Sash.

Cincinnati, Thomas Lee, 128 W. Second Street. Double Hung, Pivoted Upper Sash.

Cincinnati, Witt & Brown, 215 W. Third Street. Pivoted Upper Sash.
Cleveland, Riester & Thesmacher Co., 1514-1526 W. 25th Street. Pivoted Upper Sash.
Kansas City, Henry Weis Cornice Co., 1811-1815 Wyandotte Street. Pivoted, Double Pivoted, Single Pivoted, Stationary.
Kansas City, Zahner Manufacturing Co., 12 West 10th Street. Double Hung, Pivoted Upper Sash.
New York, Voigtmann & Co., 427 W. 13th Street. Pivoted Upper Sash.
Philadelphia, David Lupton's Sons Co., Allegheny Avenue and Tulip Street. Casement, Double Hung, Pivoted Upper Sash.
Philadelphia, J. S. Thorn Co., 20th and Allegheny Ave. Double Hung, Pivoted Upper Sash.
Salem, O., W. C. Mullins Co. Double Hung, Pivoted Upper Sash.
St. Louis, Eagle Metal Works Co., 1510-1512 Clark Avenue, Double Hung.
St. Louis, Mesker & Bro., 421-519 S. Sixth Street. Pivoted, Double Pivoted, Single Pivoted, Double Hung, Stationary.
St. Louis, Powers & Boyd Cornice and Roofing Co., 3614-3616 Laclede Avenue. Double Hung.
St. Louis, Ruth Cornice Works, 4298 Page Avenue. Double Hung.

WIRED GLASS.

It has not been judged necessary to extend label service to this material up to the present time. Distinctive marks applied by the companies themselves to that portion of their product constructed in accordance with the standard (without constant supervision of such marking by the Laboratories) has been considered acceptable.

New York, N. Y. Mississippi Wire Glass Co.

This company claims exclusive right to the use of hexagonal mesh in wired glass. Decision of the Court of last resort on this claim is not yet obtained. In the meantime sub-standard wired glass using hexagonal mesh is occasionally found on the market. Members should therefore make careful inspection of this type of product before acceptance.

Philadelphia, Pa. Continuous Glass Press Co.
Marking: Consists of a strand of the wire mesh made by twisting two No. 27 gage wires together, and spacing such distinctive cabled strand approximately 10 inches apart in each sheet of glass manufactured.

Streator, Ill. Western Glass Co.
Marking: Consists of five loops at each vertical strand of wire mesh.

W. H. MERRILL, *Secretary.*

LIST OF MEMBERS ELECTED BY THE EXECUTIVE COMMITTEE SINCE LAST NOVEMBER.

DECEMBER, 1907.

ACTIVE.

Fire Underwriters' Electrical Bureau, 95 William Street, New York, N. Y.

ASSOCIATE.

Mr. Frank A. Brown, with Fireman's Fund Insurance Company, 401 California Street, San Francisco, Cal.
Mr. Percy B. Jarvis, Special Agent, Security Insurance Company, P. O. Box 787, Syracuse, N. Y.
Mr. Konstantin Jouravleff, Insurance Engineer, Russian American Commercial Company, 43 Exchange Place, New York, N. Y.
Mr. Cornelius J. Mahoney, London and Lancashire Fire Insurance Company, and Orient Insurance Company, 59 William Street, New York, N. Y.
Mr. James McGeorge, of McGeorge, McIntosh & Chauvin, Norwood Block, Edmonton, Alta, Canada.
Mr. Alfred G. Patton, Chief Special Hazard Department, New York Fire Insurance Exchange, 32 Nassau Street, New York, N. Y.
Mr. G. H. Steuart, Assistant Secretary, Baltimore, Patapsco and Maryland Mutual Fire Insurance Companies, Baltimore, Md.
Mr. C. A. Stroebel, Special Agent, Security Insurance Company, 333 Walnut Street, Philadelphia, Pa.
Mr. R. E. Swearingen, Inspector, Underwriters' Bureau of the Middle and Southern States, 71 William Street, New York, N. Y.
Mr. W. V. Windus, Special Agent, Law Union & Crown Insurance Company of London, Box 1166, Spokane, Wash.
Mr. Paul Yarghin, Insurance Engineer, Salamandra Insurance Company, St. Petersburg, Russia.

SUBSCRIBING.

The Bureau of Public Works, Manila, P. I.
Mr. Frederick B. Dodge, Superintendent Safety Department, Tennessee Coal, Iron and Railroad Company, Birmingham, Ala.
Mr. O. B. Holloway, The Quaker Oats Company, 1600 Railway Exchange Building, Chicago, Ill.
Mr. John J. Tokheim, President, Tokheim Manufacturing Company, Cedar Rapids, Iowa.

JANUARY, 1908.

ASSOCIATE.

Mr. Cushman Abbott, Protection Mutual Fire Insurance Company, 77 Jackson Boulevard, Room 1206, Chicago, Ill.
Mr. Charles H. Barry, Manager, Pennsylvania Fire Insurance Company, 125 Monroe Street, Chicago, Ill.
Mr. Geo. H. Bell, State Agent, North British and Mercantile Insurance Company, 3 E. Second Street, Dayton, Ohio.

Mr. M. J. Burns, Manager, Rocky Mountain Fire Underwriters' Association, P. O. Box 1710, Denver, Col.

Mr. C. Walter Carroll, Missouri Inspection and Survey Bureau, Box 54, Joplin, Mo.

Mr. Alfred A. Farr, M. E. and Clerk, Middle States Inspection Bureau, 933 Bloomfield Street, Hoboken, N. J.

Mr. Frank J. Grube, Inspector, Fire Underwriters' Inspection Bureau, Northeast Corner 9th and A Streets, Tacoma, Wash.

Mr. F. P. Hamilton, General Agent, Queen Insurance Company, 84 William Street, New York, N. Y.

Mr. H. H. Heaford, General Adjuster, The Phoenix Insurance Company of Hartford, Conn., 159 La Salle Street, Chicago, Ill.

Mr. Robert H. Hunter, Insurance, 159 La Salle Street, Chicago, Ill.

Mr. F. E. Jenkins, New York Special Agent, Rochester German Insurance Company, Rochester, N. Y.

Mr. Aaron W. Jones, Special Agent, New Hampshire Fire Insurance Company, 85 North High Street, Columbus, O.

Mr. J. A. Kelsey, Manager, Aachen & Munich Fire Insurance Company, 84 William Street, New York, N. Y.

Mr. W. J. Littlejohn, Manager, North British & Mercantile Insurance Company, 159 La Salle Street, Chicago, Ill.

Mr. Hugh L. Meek, Special Agent, Hartford Fire Insurance Company, Wheeling, W. Va.

Mr. Thomas E. Mount, Special Agent, German American Insurance Company, 918 Hibernia Building, New Orleans, La.

Mr. E. A. Rademacher, State Agent, Home Insurance Company, 601 Railway Exchange Building, Milwaukee, Wis.

Mr. Prentiss B. Reed, Special Agent, Montgomery, Ala.

Mr. W. W. Scrimes, Superintendent Northwestern Department, Hartford Fire Insurance Company, Winnipeg, Man.

Mr. Gerald L. Schuyler, General Agent, 718 Exchange Building, Denver, Col.

Mr. Chas. E. Sheldon, Manager, Western Department, American Insurance Company, Rockford, Ill.

Mr. H. L. Staley, Stamp Clerk and Inspector, Underwriters' Association of New York State, and Secretary Board of Underwriters of Utica, 65-66 Utica City National Bank Building, Utica, N. Y.

Mr. John A. Stevenson, Stamping Clerk, South-Eastern Tariff Association, P. O. Box 832, Charlotte, N. C.

Mr. W. Chas. Truncer, Buffalo Association of Fire Underwriters, 94 Dun Building, Buffalo, N. Y.

Mr. Lucien C. Vallee, Inspector and Special Agent, Mount Royal Assurance Company, 74 Notre Dame West, Montreal, Canada.

Mr. William A. Walker, Gill & Walker, Insurance Agents, Warsaw, N. Y.

Mr. Rolla V. Watt, Manager, Royal Insurance Company, 122 Sansome Street, San Francisco, Cal.

Mr. Harry B. Weand, Secretary, Reading Underwriters' Association, 407-408 Baer Building, Reading, Pa.

Mr. Newell B. Woodworth, Fire Underwriters, 40 Wieting Block, Syracuse, N. Y.

SUBSCRIBING.

Messrs. Belden & Bush, Managers, Fire Association, R. 848, 159 La Salle Street, Chicago, Ill.
Messrs. Cravens & Cage, General Agents, Houston, Texas.
Mr. Henry B. Machen, C. E., Assistant Engineer, High Pressure Fire System, Department of Water Supply, 315 West 97th Street, New York, N. Y.
Gross R. Scruggs & Company, Fire Insurance, 341-343 Commerce Street, Dallas, Texas.

FEBRUARY, 1908.

ASSOCIATE.

Mr. E. O. Basse, State Agent, American Insurance Company, P. O. Box 314, Milwaukee, Wis.
Mr. Chas. Christensen of Christensen & Goodwin, Pacific Department Managers, American Central Insurance Company, St. Paul Fire & Marine Insurance Company and Mercantile Fire & Marine Insurance Company, 241 Sansome Street, San Francisco, Cal.
Mr. Chas. F. Danforth, President, American Association of Mutual Fire Insurance Companies, and Secretary Massachusetts Mutual Fire Insurance Union, 101 Milk Street, Boston, Mass.
Mr. L. K. Davis, with Associated Factory Mutual Fire Insurance Companies, 31 Milk Street, Boston, Mass.
Mr. Robert Earl, Fire Insurance, Herkimer, N. Y.
Mr. J. F. Edmonds, Resident Secretary, Commercial Union Assurance Company, Ltd., and Palatine Insurance Company, Ltd., Box 1578, Denver, Col.
Mr. A. W. Giesy, Special Agent, 308 Couch Building, Portland, Ore.
Mr. H. Henne, Chief Inspector, Aachen & Munich Fire Insurance Company, Aachen, Germany.
Mr. Henry B. Heywood, State Agent, Hartford Fire Insurance Company, 1506 North New Jersey Street, Indianapolis, Ind.
Mr. C. S. Hill, Special Agent, 106 Boston Building, Denver, Col.
Mr. John C. Ingram, Assistant Manager, German American Insurance Company of New York, 125 Monroe Street, Chicago, Ill.
Mr. Bruce Kaltz, Special Agent, P. O. Box 2123, Spokane, Wash.
Mr. W. H. La Boyteaux, Resident Partner, Johnson & Higgins, 120 Battery Street, San Francisco, Cal.
Mr. L. F. Lamping, Special Agent and Adjuster, North British & Mercantile Insurance Company, 105 Sherlock Building, Portland, Ore.
Mr. W. W. Lenox, Special Agent, Hartford Fire Insurance Company, Box 46, Albany, N. Y.
Mr. McNear, of McNear & Wayman, General Agents, Sansome and Sacramento Streets, San Francisco, Cal.
Mr. G. S. Minty, Inspector for Canada, of the Rochester German Insurance Company, Toronto, Canada.
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Mr. Eugene C. Smith, Inspector, St. Louis Insurance Survey Bureau, 523 Odd Fellows Building, St. Louis, Mo.
Mr. Alfred Stone, 49 Westminster Street, Providence, R. I.
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Mr. J. L. Whitlock, Manager of Western Department, Glens Falls Insurance Company, 159 La Salle Street, Chicago, Ill.
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Mr. J. W. C. Wright, Vice-President, New Orleans Furniture Manufacturing Company, New Orleans, La.

Editorials.

Under the report of the Secretary it will be noted that the Twelfth Annual Meeting of this Association will be held at Chicago, Tuesday, Wednesday and Thursday, May 26, 27 and 28. It is hoped that there will be a full attendance as there are many matters of interest to be brought forward at this meeting. Advance reports from several of the committees will be found in this number of the "QUARTERLY" and members should bring the "QUARTERLY" with them to the meeting.

There have been more than the usual number of interesting fires since the first of the year, particularly in the better class of properties, and the fire loss as a whole has been abnormally large. Experience developes weaknesses in even the best class of construction and the need of greater care and attention to details is strongly emphasized. Several serious fires have occurred in buildings of so-called "fire resistive" construction, and one in a very massive building of the so-called "slow burning" type.

A detailed report on the Parker Building fire has been made by the New York Board of Fire Underwriters and copies mailed to members. This building was a twelve-story large area building of the steel skeleton, terra cotta floor type with terra cotta protection for the steel members. It was lightly constructed for the occupancy which was tenant mercantile and light manufacturing. The fire started on the fifth floor, occupied by book dealers, and spread through poorly protected stair and elevator openings and through the outside windows to the floors above. The fire department was totally unable to cope with the fire, defective hose and weak water supply playing some part, though it is questioned if the best hose service would have been of much use with a fire of this nature and location unless promptly discovered. Before the fire had more than partially spread to the upper floors a section of the floors about 30x40 feet gave way and dropped from roof to basement. This was probably due to defective insulation of the metal columns, or to defective column or girder, combined with the fact that the floors were undoubtedly more or less overloaded. This allowed fire to spread almost immediately to all floors with the result that practically all of the contents were destroyed and the loss to building will be very heavy. A considerable part of the terra cotta floors gave way or will have to be replaced. The steel frame is probably in fair condition except where the collapse occurred. Some of the chief defects in construction may be mentioned as large open areas, poorly protected floor openings, weak floor arches, insufficient or defective proofing for metal members, cast iron columns with girders too lightly fastened to same, fire department service not able to cope with fires in buildings of this height, area and occupancy.

A detailed report is given in this number of a fire in a reinforced concrete building occupied for manufacturing automobiles. The building

was new, only partially occupied and was being equipped with sprinklers. It appears that fire spread to some extent from one floor to another through the outside windows and but for the fact that there was comparatively little combustible material in the upper floors, these floors would probably have been gutted as was the fourth where the fire started. There have been several fires in "fire resistive" buildings where fire has spread from one floor to another through outside windows and it appears that there is need of wire glass windows or shutters to prevent this, especially in buildings of manufacturing or mercantile occupancy, this regardless of outside exposure. The concrete was quite seriously damaged in places, the reinforced members being exposed, and it is possible that a more serious fire might have resulted disastrously.

A fire resistive building in Chicago of mercantile occupancy was seriously damaged by an exposure fire because of lack of window protection, again emphasizing the fact that one of the greatest if not the greatest weakness in our city risks is the lack of protection for wall openings thus allowing fire to spread from one building to another. No matter how well the buildings themselves may be constructed they cannot but act as feeders to the spread of fire when filled with combustible material and with walls full of unprotected openings.

A serious fire in a sprinklered risk in Philadelphia is of peculiar interest in that the construction, protection, and occupancy were in favor of satisfactory control of fire by the sprinklers, and furthermore, so far as can be learned, the system was in service, with a good primary water supply from large tanks, giving about thirty pounds pressure. The fire occurred in the mule spinning room, and at least most of the sprinklers operated. The fire, however, spread through the room and by means of floor openings reached the floors above. The sprinklers were of an old type and were probably somewhat slow in operation and faulty in water distribution and, furthermore, one report states that some of the piping or sprinkler openings were clogged with mud and sediment. This seems to emphasize two important features: (1) The questionable action of the older type sprinklers; and (2) the condition of the pipes as regards clogging.

There are many sprinklers in use today which have been installed for twenty years or more, and while these old types were quite satisfactory in their day, the modern approved types are recognized as much superior, and it is only reasonable to expect great progress in an art which is not yet thirty years old. While, therefore, these old type heads have given generally good results, it would appear that they have deteriorated to some extent at least, and those who have investigated these devices seem to agree that the only safe course to pursue is to change these old sprinklers for modern approved types, numerous tests having shown that this is not only generally advisable but in many cases absolutely essential.

The danger of the clogging of pipes of course is always present, and while the fire record shows that this danger is comparatively slight, it is considered worthy of careful investigation, and we already have records of several fires where sprinklers failed to operate properly because of mud or sediment. Probably the only practical way to determine the real

condition is to remove some of the sprinklers or end fittings and examine or blow out the piping. The danger of clogging undoubtedly varies according to localities, it being evident that in some cases there is much more sediment than in others.

In the Fire Record is given a report on a fire in an especially heavily constructed warehouse in Indianapolis, which is of peculiar interest in that it shows the possibilities of fire spreading through small openings and the need of especial care in the details of construction. This spread on the outside of a small dumb-waiter, burned through the top to the floor above, then spreading through holes in the wall where timbers entered to an adjoining section, so that several sections of a building, supposedly well cut off, and of exceptionally heavy construction, suffered a serious loss. The Fire Record shows that many buildings of supposedly good construction have not received proper attention as to details, and emphasizes the need of careful inspection when being built and frequent reinspection to see that changes are not made which introduce serious defects.

The loss of life by fire in the last two or three years has been so serious as to call more than ordinary attention to the dangers which exist, and the need of reform in many directions is emphasized. Among the more notable instances are the theatre fire in Chicago, the excursion boat in New York, the hall or theatre in Pennsylvania, and finally the school in Ohio. In these few fires alone the deaths run into the thousands, but while each at the time caused considerable comment, and in some cases improvements resulted, yet as a whole the conditions are practically the same, and we have innumerable examples of dangerous conditions in our theatres, schools, hospitals, asylums, retail stores, etc., it being remarkable that we do not have more of these terrible examples of loss of life. A few months ago there was a fire in a large retail store in Cincinnati which just escaped being a terrible disaster. The building was of the ordinary light construction with floor openings, and fire started shortly after the noon hour in a show window on first floor. It is stated that in eight minutes the entire building was on fire. One employee lost her life and two others were seriously injured.

The following fires were reported in one day's issue of the Commercial Bulletin of New York, the frequency of such fires emphasizing the great need of reform.

"Sturgeon Bay, Wisconsin. Principal school building burned. Loss $60,000."

"Rockhill, Texas. Public school three-story frame building burned."

"St. Louis, Missouri. A fire panic was narrowly averted at the city poor house early today by the coolness and determination of a lone city fireman regularly stationed there. The 1,200 inmates were asleep when he discovered that the laundry in the basement was on fire. He fought the fire with a hose and twice was driven out by the dense smoke but finally extinguished the flames."

"St. Johns, Michigan. While smoke came up the flues into the school rooms and halls of the North Ward School today the 125 pupils marched

out without the vestige of a panic despite the fact that the fire drill had not been given in some time."

In Chicago, a theatre of supposedly good construction was used before all of the necessary safeguards were completed. Someone was at fault.

The captain of the excursion steamer was found guilty of criminal neglect, the judge's opinion being in part as follows: "The excuses advanced on behalf of the defendant and so ably presented by the counsel, if sustained by this Court will put a premium on misconduct and a neglect of duty."

In the little Pennsylvania town a hall was being used for an entertainment with moving pictures. Oil lamps were used for footlights and the location of hall on second story of a lightly constructed building without proper exits brought about disaster with frightful loss of life.

In the school fire in Ohio, the coroner stated that the death of the children was due to faulty construction whereby a partition projected in front of a stairway.

The question has often been asked, "What are you going to do about it?" Experience shows that the American public are generally indifferent to things which do not immediately concern them, and are probably willing to take chances to a degree that may perhaps not be true of any other civilized nation. Individuals and corporations are allowed to construct buildings in which many people are at times congregated, without regard to proper safety, and while in some communities building laws exist which help matters to some degree, in most cases little or no attempt is made to safeguard life. Furthermore, our states and cities set before us thoroughly bad examples in poorly constructed public buildings, where serious loss of life is possible if not probable.

The answer to the question of "What are you going to do about it?" seems to largely lie in the further question of "Who is responsible?" and this again depends on whether it is feasible to so construct buildings that they are safe to a reasonable degree.

The last few years have seen a marked advance in the improvement of buildings, constructively and protectively, and there would seem to be but one answer to the question of whether it is feasible to provide buildings which are relatively safe so far as either loss of life or serious fires are concerned. While there may have been some excuse in years gone by in constructing buildings of the "fire trap" order, there certainly is not today, and the cost of modern "fire resistive" construction is so little more than ordinary construction that it should never have any weight so far as the class of buildings is concerned where people congregate in any numbers. Furthermore, such rapid strides have been made in fire protection that it is entirely feasible to improve poorly constructed buildings so as to make them reasonably safe. For instance, we have had sufficiently long experience with the automatic sprinkler to be certain of its value, and even in inferior buildings we find that the danger of serious fires has been largely eliminated. This type of protection is not expensive, comparatively speaking, and should be required in all cases where there is danger of serious loss of life, including schools, theatres, halls, public buildings, etc.

The whole matter then resolves itself into whether or not the property owner is responsible for loss of life if he does not provide well-known and reasonable safeguards, both as to construction and protection. Would it be going too far to hold the property owner criminally responsible for loss of life in stores, theatres, or other buildings, in case all reasonable precautions have not been taken? This would, of course, apply as well to public buildings, and it would seem that the public should be in a position to require proper construction and protection for their schools and other public buildings.

Has not past experience shown us that unless some individual or individuals are held responsible, dangerous conditions will continue to exist?

The National Fire Protection Association is endeavoring through its members to improve conditions and it should have the co-operation and support of the property owner. It has under way a campaign of education for improved methods of fire protection and fire prevention. This should interest the public who are bound to suffer from serious fire losses until conditions are changed, and while in many cases the danger has been lessened it is still prominently before us, and for some time at least will continue to be one of the most important problems confronting our national prosperity and safety.

Wet Pipe Versus Dry Pipe Automatic Sprinkler Systems. In connection with the sprinkler fire record of various classes of occupancies there has been published a table (No. 16) showing the relative efficiency of wet and dry sprinkler systems. This table gives the number of fires, the average pressure, and the average number of sprinklers opened under each system; with these same features divided according to whether the fire was extinguished, held in check or unsatisfactory. In all there have been nine general classes reported upon. Combining these figures we have the following table:

Efficiency of Wet or Dry System.					Number of Fires.			Per Cent. of Fires.		
	Number of fires	Per cent of fires	Average Pressure	Average number opened	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory
Wet system,	974	71	58	5.2	681	236	57	70	24	6
Dry system,	392	29	60	11.7	236	112	44	60	29	11
Total,	1366		59	7.0	917	348	101	67	26	7

It will be noted that about 30% of all fires occurred in risks protected by the dry pipe system. The average pressure was about the same with either system. The average number of sprinklers opened was considerably more than twice as many with the dry system as with the wet system. The percentage of unsatisfactory fires was nearly twice as great with the dry system as with the wet.

It is evident that there are several theoretical disadvantages with the dry system, the question being as to how important these are from a practical standpoint. For instance, a certain length of time must elapse between the opening of the sprinklers and the issuing of the water from the sprinkler orifice. In small systems a fair average as to time elapsing might be given as 30 seconds, while with larger systems it might easily be two or three times as great. This of course means that the fire has that much more time to spread. Another theoretical disadvantage is the necessary use of a dry pipe valve, a mechanical device which, however well designed or constructed, necessarily introduces additional complications and possibilities of trouble. Furthermore the interruptions to service are proportionately greater with the dry pipe system because it is more difficult to maintain, requiring as it does the maintenance of an air pressure in the system itself as well as perfect drainage to prevent freezing.

The tables seem to bear out at least some of these theoretical objections in that the average number of sprinklers opened is larger showing that the average fire spreads further before being held in check or extinguished. Also, as already mentioned, the proportion of unsatisfactory fires, that is fires where the sprinklers failed to properly control the fire, is nearly twice as great with the dry system as with the wet system. In actual number there were 44 unsatisfactory fires with the dry system and 57 with the wet system.

A brief analysis of these 44 dry system failures may be of interest.

Defective dry valve or apparatus	4
Too many sprinklers on a dry valve	4
Slow action of dry system combined with obstructions	2
New dry valve being installed	1
Freezing of improperly drained system	1

Making a total of 12 fires where the unsatisfactory action of the sprinklers is largely if not entirely due to the fact that it was a dry system. This it will be noted is a little over a quarter of the whole number of unsatisfactory fires on a dry system.

The other 32 fires may be classified as follows:

Fire started in unsprinklered portions	6
Water shut off	5
Sawdust or other dust explosions	4
Generally defective equipment	3
Exposure fires	3
Dry kiln fires	3
Dip tank fires	2
Miscellaneous	6

The 12 unsatisfactory fires where the dry system was accountable for the failure of the sprinklers illustrate several important features.

First, the necessity for using only approved dry pipe apparatus, this eliminating as much as possible the chances of failure of dry pipe valve itself.

Second, the advisability of a small number of sprinklers on a single dry system. (The rules require not exceeding 500 heads on a single dry valve.)

Third, system to be arranged so as to drain properly and great care to be taken that all water has been drained from system during cold weather.

Fourth, whenever a dry valve is sent away for repairs or a new dry valve being installed care must be exercised to keep water on system as much as possible or have system intact so that water can be turned on in case of need. The rules require that a dummy flange be kept on hand so that it may be inserted in the riser and thus keep the system intact.

With dry systems it is more than ever necessary to have outside control for the sprinkler system so that water may be turned on sprinklers without going into the building.

Cordage Works---Fire Record.

Total number of fires, 149.

1. CLASSIFICATION OF CAUSES.

Common Causes.

LIGHTING. Number of fires, 2.
Fuse in rosette blew out and ignited roof timbers and binder twine wrappings.
Parlor match used in lighting gas.
HEATING. Number of fires, 1.
Overheating of stove.
POWER. Number of fires, 4.
Hot bearings, 2 fires.
Overheated journal.
Friction of gears in brick shaft tunnel.
BOILER (or fuel). Number of fires, 5.
Sparks from boiler ignited rubbish on floor.
Sparks from boiler in kindlings.
Sisal waste caught fire while being fed into furnace.
Ignition of soot or oil drippings on top of boiler.
Walls too near ash pit.
RUBBISH (or sweepings). Number of fires, 0.
OILY MATERIAL. Number of fires, 0.
SMOKING. Number of fires, 1.
Caused by employee smoking.
LIGHTNING. Number of fires, 3.
LOCOMOTIVE SPARKS. Number of fires, 0.
MISCELLANEOUS. Number of fires, 4.
Matches on floor, 4 fires.

Special Hazard Causes.

BALED STOCK. (Jute.) Number of fires, 7.
Spontaneous combustion in baled jute, 3 fires.
Originated in baled jute, 2 fires.
Unknown in baled jute, 2 fires.
DRYING. Number of fires, 5.
Stock on steam pipes in dry room.
Loose fibre in contact with steam pipes in dryer.
Overheated dryer.
Unknown in drying machine.
Unknown in dry room.
PICKERS (including openers). Number of fires, 45.
Friction in picker, 13 fires.
Foreign substance in stock passing through picker, 31 fires.
Hot box on picker machine ignited hemp.

STOCK CONVEYORS. Number of fires, 2.
Friction in conveyor system ignited stock.
Originated in stock conveyor.
CARDS. (Including combing and spreading.) Number of fires, 37.
Friction in card, 17 fires.
Foreign substance in stock, 19 fires.
Occurred in spreader.
DRAWING. Number of fires, 1.
Friction in drawing machine.
SLUBBING AND SPINNING. Number of fires, 3.
Friction in spinning machine.
Friction in slubber.
Friction caused by hemp twisting around bobbin or machine and binding.
MISCELLANEOUS. Number of fires, 2.
Ignition of rope after removed from dryer and piled in corner of room.
Unknown in pile of finished binder twine.

Summary.

Common Causes.

	No. of Fires.	Per Cent. of Whole.
Lighting	2	1.6
Heating	1	.8
Power	4	3.3
Boiler (or fuel)	5	4.1
Rubbish (or sweepings)	0	0
Oily Material	0	0
Smoking	1	.8
Lightning	3	2.5
Locomotive Sparks	0	0
Miscellaneous	4	3.3
Total Common Cause Fires	20	

Special Hazards.

Baled Stock (Jute)	7	5.7
Drying	5	4.1
Pickers (including Openers)	45	36.9
Stock Conveyors	2	1.6
Cards (including combing and spreading)	37	30.3
Drawing	1	.8
Slubbing and Spinning	3	2.5
Miscellaneous	2	1.6
Total	102	

	No.	Per Cent.
Common Causes	20	16
Special Hazards	102	84
Total	122	
Incendiary	1	
Exposure	2	
Unknown	24	
Total Cordage Fires	149	

2. DETAIL OF CAUSES.

Common Causes.

748. Shaft tunnel is all brick except at man-hole where there is wood flooring at top. Bearings are on stone piers. Fire occurred in large man-hole where there are two large bevel gears. One gear has wooden teeth and the other iron. The only combustible material in pit was the wooden teeth, a wooden ladder, two small wooden uprights and the plank floor above with wooden trap. Previous to fire there may have been some waste or hemp dust or other combustible material in pit but no evidence of this remains. All of the woodwork noted above is badly charred and cannot determine just where the fire started. Possible cause is friction of wood gear teeth, or hot box setting fire to combustible material. At last survey inspector asked to have sprinklers placed in shaft tunnel and if this had been done there would have been little or no loss. Fire burned through floor and set fire to rope on floor but fire damage was small as three sprinklers opened directly above and at once extinguished fire. There will be some loss on rope damaged by fire and water, practically no loss on building and machinery.

Special Hazards.

630. Fire apparently originated at top of wooden conveyor used for conveying jute from picker house to carding room on third floor. The belt in the conveyor was badly charred and fire communicated to the carding room where it was held in check by the sprinklers.

1560. Fire in dryer caused by loose fibre against steam pipes.

1769. Heated rope piled in a corner after being removed from dry box contrary to rules, so superintendent stated. Spontaneous combustion caused fire.

2202. Gear on carding machine breaking causing discharge roll to stop and cylinder continuing to work, friction was created which set fire to jute.

4286. The mill had shut down for the noon hour and no one in the Card Room. A yard hand saw smoke through a window and gave the alarm. The fireman, yard watchman, and others at once attached lines of hose to hydrants and four streams were used. The fire starting in one end extended through two slubbers. The room filled with smoke, and not being able to locate the fire, the entire room was drenched by the hose streams. Twenty-three revolving top flat cards

(45") were wet and the clothing ruined. Most of the rolls on the slubbers will have to be re-covered. The building was not damaged. There was not much stock in the room and except in the immediate vicinity of the slubbers, nothing was burned.

4847. Fire started in a two-story brick arch ceiling picker room and spread through frame carrier chute across the yard to third story of mill.

5501. Fire in large frame dryer machine used for drying jute. Probably caused by overheating.

6566. Hot box on picker machine ignited the hemp.

3. ROOMS IN WHICH FIRE OCCURRED.

	Special Hazard.		Common Cause.		Unknown Incendiary Exposure.		Total Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Storage and Non-Manufacturing ...	9	9	4	25	14	61	27	19
Boiler	..	..	5	31	1	4	6	4
Shaft Tunnel	..	..	1	6	..	..	1	1
Dry Room	6	6	..	..	..	..	6	4
Picking Room	40	40	2	13	2	8	44	32
Conveying	2	2	..	..	..	..	2	1
Carding Room	39	39	1	6	1	4	41	29
Spinning Room	2	2	..	..	2	9	4	3
Calendering and Polishing Room	1	1	1	6	..	..	2	1
Tarring Room	..	..	..	..	1	4	1	1
Laying Room	..	..	1	6	..	..	1	1
Repairing Room ...	1	1	..	..	1	4	2	1
Bell tower and roof.	..	..	1	6	1	4	2	1
Total with data given	100		16		23		139	
No data	2		4		4		10	
Total	102		20		27		149	

4. DAY OR NIGHT. (Day Fires 6 a. m. to 6 p. m.)

	Special Hazards.		Common Causes.		Unknown. Incendiary, Exposure		Total Fires.	
	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.
Day	93	94	15	75	13	50	121	83
Night	6	6	5	25	13	50	24	17
Total with data given	99		20		26		145	
No data	3		0		1		4	
Total	102		20		27		149	

5. PLANT IN OPERATION.

	Special Hazards.		Common Causes.		Unknown. Incendiary, Exposure		Total Fires.	
	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.
Plant in operation	88	96	10	67	6	43	104	86
Plant not in operation	4	4	5	33	8	57	17	14
Total with data given	92		15		14		121	
No data	10		5		13		28	
Total	102		20		27		149	

6. HOW DISCOVERED.

	Special Hazards.		Common Causes.		Unknown. Incendiary, Exposure		Total Fires.	
	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.
Employee	90	94	8	57	6	35	104	82
Watchman	2	2	4	29	9	52	15	11
Thermostat	0	0	0	0	0	0	0	0
Sprinkler Alarm	4	4	1	7	1	6	6	5
Outsider	0	0	1	7	1	6	2	2
Total with data given	96		14		17		127	
No data	6		6		10		22	
Total	102		20		27		149	

SPRINKLER FIRE RECORD.

7. EFFECT OF SPRINKLERS.

	No. of Fires.	Per Cent. of Whole.
Extinguished or practically extinguished fire	95	70
Held fire in check	35	26
Unsatisfactory	5	4
Total	135	

8. DETAILS OF UNSATISFACTORY SPRINKLER FIRES.

M-65. March 18, 1891. At 1.30 p. m. a fire was caused by a hot bearing on a post hanger in the laying room next to the engine and boiler house. This bearing was oiled once in two days and had been oiled at noon the day before. The laying room was protected by Parmelee sprinklers, but the engine and boiler house was not so protected. Although the sprinklers opened, the fire extended into this building and the cast-iron steam pipe supplying the pumps was cracked by a stream from hose, and fell, disabling the steam pumps.

The city water supply was deficient, being about 20 pounds pressure delivered through a 4-inch pipe containing a meter. The city fire alarm was out of order, and there was some delay before the city fire department was summoned by telephone. A steam lighter came to the dock near by and furnished a good stream through 1,200 feet of hose, and probably saved one of the buildings in the yard. The destruction of the mill was complete, and of one of the storehouses partial.

On the morning of the day that the fire occurred, one of the inspectors with an agent of a sprinkler company went to this mill for the purpose of arranging a complete and satisfactory revision of the installment of sprinklers and substituting more sensitive sprinklers for those in use. Loss $590,881.

Summary: Defective sprinklers.

M-173. September 23, 1891. Fire was discovered at 7.10 p. m. in a storehouse full of jute. This storehouse was divided into three compartments. The man who discovered the fire ran through the storehouse, neglecting to close the fire doors behind him. Sprinklers had just been put into the building, but the water was shut off at 4.30 p. m., on account of leakage in the pipes. As this was not generally known, the water was not let on again until 15 minutes after the alarm was given, which was too late for the sprinklers to be of much service. The fire was extinguished by means of streams from 12 steamers, and streams from the mill hydrants.

This fire is believed to have been the first instance where a standard mill floor of slow-burning construction without any holes has burned through. In the middle compartment there was a portion so difficult of access that streams could not be put upon it, and after five hours the fire burned a hole through the floor, which consisted of 3-inch spruce plank covered with a 1⅛-inch top flooring. As has occurred in other similar fires, the wetting of the bales of jute caused them to expand to such a degree as to push down cross walls and to force posts from their bases, although embedded in concrete. The great part of the loss was due to water damage. Loss $22,684.23.

Summary: Water shut off.

949. Brooklyn, N. Y. April 21, 1900. Fire occurred in jute storehouse at 2 a. m. Discovered by watchman. Brick walls, joist construction. Storehouse was equipped with Grinnell issue "D" sprinklers, dry pipe system supplied by city water, 50 pounds pressure and automatic steam pump 80 pounds pressure. Dry system with one Grey toggle joint dry valve controlling four storehouses and dock shed. Each of the five storehouses had a check valve at foot of risers so that system would operate more quickly. Apparently the heads opened and dry valve tripped promptly. There were about 6,600 bales of jute butts in storehouse piled to within seven feet of the roof which was 35 feet above the ground. The sprinklers appear to have had little effect, probably owing to obstructions from the jute bales. One hundred sprinklers in the room and all opened. The roof was burned through. There was good outside protection from fire department and fire boats and fire was finally controlled by hose streams. Double standard fire doors to adjoining storehouses were

kept closed and fire did not get out of the building. Large loss to stock from both fire and water.

Summary: Obstructions to distribution.

4510. Easton, Pa. February 20, 1906. Fire started on third floor of factory, brick joist construction, peak roof, open finish, occupied as preparing room. Fire caused by foreign substance in the hemp picker. Risk was equipped with Grinnell issue "D" sprinklers, 102 in room. Wet system, supplied by a 7,500 gallon gravity tank and a 500 gallon steam pump. Old style spacing and arrangement. Sprinklers were of some service but failed to hold the fire in check and the peak of the roof was burned off. Pipe sizes were overloaded and there was a hose connection which reduced the pressure on the sprinklers. The fire was confined to the third floor by the aid of hose streams. Pump did good work and was run for about two hours and a half.

Summary: Defective spacing and arrangement.

6215. Chelsea, Mass. September 26, 1907. Idle plant. Fire occurred in tar house adjoining main building from an unknown cause, possibly incendiary. Sprinklers failed to hold fire in check. For details see "Quarterly," No. 3, January, 1908. Fire 6215, page 167.

Summary: Not classified.

9. DETAILS OF LARGE LOSS SPRINKLER FIRES. (Where sprinkler control is satisfactory.)

M-48. February 18, 1891. Fire in a picker at 3.30 p. m., was caused by foreign substance in the stock. The fire spread through holes in the floor to the room above. It was extinguished by Grinnell automatic sprinklers and mill hose. The fire alarm was struck but the department did not arrive for 25 minutes, owing to confusion caused by the simultaneous striking of another alarm in a different part of the city. Loss $13,147.28.

Summary: Floor openings.

789. Xenia, Ohio. September 17, 1899. Fire occurred in brick warehouse one-story, cement floor, joisted roof, 50x100 feet used for storage for manilla and hemp. Equipped with Neracher sprinklers, water on system, supplied by city water, fifty pounds pressure. Three sprinklers opened and held fire in check, but hose streams had to be used and there was a water damage of about $15,000.

Summary: Obstructions to distribution.

1307. Chicago, Ill. December 20, 1900. Fire occurred in main mill, third floor. Twenty-seven sprinklers opened being fed by automatic pump under good pressure, and held the fire in check. Fire department used hose and it appears that excessive water damage resulted. Loss about $13,000.

Summary: Excessive water damage from hose streams.

1620. Brooklyn, N. Y. November 11, 1901. At 9.30 a. m. fire occurred in storehouse No. 14. The mill was running and stock was being trucked in and out of basement when fire started. When first seen the bale of jute on the truck and some in the pile were on fire. The fire flashed over the pile so quickly that the men were forced to leave their clothes hanging in the room. The smoke was dense. The water was quickly turned on from the hose. In the meantime 11 sprinklers opened. The fire department arrived. The time required

to bring the mill apparatus in use was one minute; the public department five minutes. The duration of the fire was four hours and some fire was observed three hours later.

The basement was three-quarters full of jute, piled seven bales high on the flat, with two feet open space above the bales under the sprinklers. The greatest amount of damage was between the piles and low down where the sprinklers could not at first reach the fire. Loss $15,083.62.

The insurance on building No. 14 and stock was seventy-five thousand dollars ($75,000); the quantity of jute therein, twenty-four hundred and forty-eight (2,448) bales; sound value not stated. In view of the small proportion of the loss to the amount of insurance carried and the probable value of the stock at sound value, this fire may be deemed to have been very well handled.

Summary: Obstruction to distribution.

M-47. Brooklyn, N. Y. January 31, 1904. At 8.20 p. m. the night fireman saw smoke coming into the boiler room around the edge of the fire-door leading to warehouse 2A. As he started to notify the night engineer, he met him, the engineer having heard the sprinkler alarm and seen the automatically governed pump start up. Storehouse 2A, which contained 3,200 bales of jute butts and 200 bales of manilla hemp, was found full of smoke and the sprinklers in operation. An alarm was at once given, and the employees soon got streams from the mill hose on the fire. The four public alarms brought out the fire department with 34 engines and a fire-boat, in about six minutes. About 30 hose streams, including four from the fire-boat, were used, the fire being fought from the doorways and through the skylights in the roof. Some 50 sprinklers opened, including a line of extra heads around the room, up near the roof, which had been added since the last fire, with a view to protecting inaccessible points. The jute, which was piled about 40 feet high, was completely enveloped in water from the hose streams and sprinklers. The sprinklers were shut off several times, but the fire at once blazed up and the valves were again opened. After a time the firemen decided to cut away the roof to give more vent, and two-thirds of the roof was destroyed. It would seem that this was unnecessary. The sprinkler system, which was thereby ruined, was holding the fire, and the hose streams could do no more until the pile was broken down, which at the time was impossible in the confined space. The fire burned in the middle of the pile several days, all the bales having burst open, but it was gradually extinguished.

Early in the fire some 30 firemen entered the room, one after another, through a doorway at a corner, disappearing in the thick cloud of smoke. No word coming back from them, fear for their safety was awakened. They were all found unconscious, lying on the floor in the water. One was dead when taken out, two others died soon after, and 18 were carried to the hospital. While the firemen entering this doorway had been overcome, the superintendent and some of his men had been passing in and out of a doorway at another corner of the room without feeling unusually bad effects from the smoke. The explanation of this at the mill is, that the water falling from the sprinklers and hose streams from the roof forced downward towards the

door through which the firemen entered a current of deadly smoke and vapor, which overcame the men as soon as they reached it. The fact that the men on the roof saw no smoke come out of the open skylights seems to support this theory.

This fire occurred on Sunday night while the mill was not running and no repairing work being done. The watchman's records show that he was in this room at 7.45 p. m. In the absence of even a theory as to the cause of this and previous fires in this compartment, our inspector thinks that they are in some way connected with the fact that this particular compartment is used to a considerable extent as a thoroughfare from the boiler house into the main passageway. He recommends that this door to the boiler room be closed, or an enclosed fireproof passageway be built.

The water which was poured into the room accumulated on the floor to the depth of at least a foot and ran through the doors into adjoining compartments, wetting the ground tier of stock in all this group of storehouses. Loss, $7,000 to $10,000.

Summary: Obstruction to distribution.

5339. Brooklyn, N. Y. May 20, 1906. At about 11 p. m. the watchman heard the alarm bell connected with the sprinkler equipment in warehouse ringing. Upon investigation it was found that a fire had occurred on the seventh floor. The stock on this floor consisted of about 1,000 bales of jute and Italian and American hemp, which had been put in at different times, from ten days to four months previous to the date of the fire. No one, with the exception of the watchman, was known to have been in the building for more than 30 hours previous to the time the fire occurred.

The cause of the fire is difficult to determine; it may have been caused either by spontaneous ignition in the stock or by some person getting into the building and smoking. As soon as the fire was discovered the pump was immediately started and run at a pressure of 100 pounds. One large hose stream and four small ones were brought into play; two automatic sprinklers also opened and without doubt they alone would have been sufficient to have extinguished the fire.

The floors of this building are of a water-proof character, asphalt being laid directly upon the flooring and all cracks between same and walls thoroughly caulked. The result was that, although there were from two to four inches of water on the floor, very little or no water went through to the floors below, the damage being wholly to stock on the floor where fire occurred. The fire itself did not extend beyond 10 or 15 bales of hemp. Immediate attention was given to the stock and same will be taken care of to save all damage possible. Loss, from $4,000 to $5,000.

Summary: Obstruction to distribution.

5341. Wilmington, Del. May 23, 1906. Fire started in freight car filled with jute standing on siding just outside north wall of storehouse. It entered building through doors and windows and opened up three sprinklers on the first floor and five on the second floor. The storehouse was of brick, open joist construction, double board floors and occupied for storage of jute in bales and finished twine. The sprinklers aided by hose streams held the fire in check but a large

amount of stock was wet down making a considerable loss. Loss $9,000.

Summary: Exposure.

5624. Brooklyn, N. Y. February 5, 1907. Fire occurred in basement of first building used for storage of jute stock. Started at 9.30 a. m. Cause unknown, but supposedly spontaneous combustion in a bale of jute. Brick building, mill construction. Risk equipped with Grinnell glass disc sprinklers, old standard, wet system, supplied by a 750 gallon steam pump, 60 pounds pressure and water works 40 pounds, the latter not being a factor. Forty-five sprinklers opened and held the fire in check aided by public and private hose streams.

Fire occurred from some unknown cause in a pile of baled jute but as the raw and jute sliver bales were piled side by side, it was impossible to determine in which the fire originated. The bales were piled closely together in rows and within about two feet of the ceiling. As soon as the employee discovered the fire, the pressure regulator was cut out and the pump pressure increased to 120 pounds, and two 1⅛-inch streams from private 2½-inch hose, and four ⅝-inch streams from 1-inch hose were brought into service. After a few minutes, fearing that they could not extinguish the fire unaided, the men turned in a public alarm. The department responded in four minutes, and the acting chief immediately sent in a third alarm. No difficulty was experienced in controlling the fire and it was extinguished in about an hour and a half, although they continued wetting it down for about two hours and a half longer.

Most of the damage was from effects of water on the stock, the building loss consisting of broken windows, hole chopped through floor, etc. Loss about $25,000.

Summary: Obstruction to distribution.

6420. Ludlow, Mass. August 6, 1907. Brick storehouse, mill roof, used for storage of baled American hemp. Twenty-five sprinklers opened and aided in holding fire in check. Loss was heavy from water. Loss $30,000 to $35,000. For details see "Quarterly," No. 2, October, 1907. Fire No. M-8-6-07, page 120.

Summary: Obstruction to distribution.

5990. Auburn, N. Y. September 4, 1907. Frame warehouse filled with binder twine. Sprinklers held fire in check but large amount of water thrown from hose streams and very large water damage. Loss $100,000. For details see "Quarterly," No. 2, October, 1907. Fire No. 5990, page 118.

Summary: Obstruction to distribution.

5993. Philadelphia, Pa. September 14, 1907. Fire occurred on first floor of warehouse occupied for storage of jute and finished rope. Twenty-two sprinklers opened and held fire in check, aided by hose streams. About $40,000 loss. For details "Quarterly," No. 2, October, 1907. Fire No. 5993, page 119.

Summary: Obstruction to distribution.

10. POINTS OF INTEREST FROM SPRINKLER FIRE REPORTS.

Automatic Sprinklers.

5909. One story brick warehouse, 75x100 feet, plank floor, mill con-

structed roof. Equipped with Manufacturers sprinklers, dry system, new standard. Excellent water supply being automatic steam pump and large tank.

Fire occurred in a block of about 500 bales of jute, covering an area of about 14x30 feet and piled nine and ten bales high. This jute was stored in the left hand corner of warehouse and had not been disturbed since it was placed therein last May (1906). Several men were at work in the building storing hemp and jute when the fire broke out and immediately gave the alarm. The sprinkler system operated promptly and by the time the fire department arrived the fire was under control. The burning bales were quickly pulled down and smouldering patches extinguished with one hose stream. This fire serves to again illustrate the value of automatic sprinklers in warehouses of this class and shows conclusively that such fires can be extinguished with but slight loss to contents and none to building, if intelligently handled.

Note the fact that but one hose stream was used, as against eight hose streams at the fire of February 23rd in Warehouse No. 75, also that no damage was done to the building by the Fire Department. Of the 5,000 bales of stock in the warehouse only those involved directly in the fire were wet down.

Dry System.

3182. Twenty-four sprinklers opened. System probably slow in action as sprinklers were on same dry system as main building. Quick hot fire.

Obstruction to Distribution.

126. A platform about three feet from the floor extended from the back of the picker to the wall. Fire started underneath this and water from sprinkler could not reach it.

272. Small shelf behind machine about four by five feet prevented water from reaching fire.

11. NUMBER OF SPRINKLERS OPENED.

	Extinguished Fire.		Held Fire in Check.		Unsatisfactory.	Total.				
No. of Sprinklers Operating.	No. of fires.	Per cent.	No. of fires.	Per cent.	No. of fires.	No. of fires.	Per cent.	No. of Sprinklers Operating.	No. of fires.	Per cent. of whole.
1	17	18	4	11	..	21	16	1	21	16
2	9	10	4	11	..	13	10	2 or less	34	25
3	13	14	6	17	..	19	14	3 or less	53	40
4	7	7	0	0	..	7	5	4 or less	60	45
5	8	9	2	6	..	10	8	5 or less	70	53
6 to 9 inc.	15	16	6	17	..	21	16	Less than 10	91	69
10 to 24 inc.	16	17	4	11	..	20	15	Less than 25	111	84
25 to 49 inc.	3	3	6	17	..	9	7	Less than 50	120	91
50 and over	6	6	3	9	3	12	9	50 and over		
Total	94		35		3	132				

Average number of sprinklers opened not including unsatisfactory, 12.4.

12. ALARM SERVICE.

	Satisfactory.		Failure.		Total.
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	
Watchman alone	10	100	0	0	10
Sprinkler alarm alone	5	100	0	0	5
Thermostat alone	0		0	0	0

	Watchman.		Sprinkler Alarm.		Thermostat.		Total.
	Satisfactory.	Failure.	Satisfactory.	Failure.	Satisfactory.	Failure.	
Watchman and Sprinkler Alarm	2	1*	2	1	..	..	3
Watchman and Thermostats	..	..	..	..	..	..	..
Sprinkler Alarm and Thermostats	..	..	1	..	1	..	1
Watchman, Sprinkler Alarm and Thermostats, ...	..	..	..	..	..	..	..

*These include fires where sprinkler alarm or thermostats notified the watchman.

Note.—These tables do not include fires where alarm service does or does not operate properly if fire is at once discovered by employee, the alarm service having no bearing on such fires one way or the other.

13. SECONDARY WATER SUPPLY.

1716. Primary supply water works, fifty-five pounds. Fifty-five sprinklers opened and steamer connection was used by the fire department to help maintain a good pressure.

1721. Primary supply pressure tank, second supply water works. Fifty-one sprinklers opened and practically extinguished the fire. The water works were of service in backing up the pressure tank.

1818. Primary supply two 10,000 gallon gravity tanks giving twenty pounds pressure. Second supply 1,500 gallon steam pump. Thirty-six sprinklers opened in a jute warehouse fire and pump was used to increase the pressure and was of considerable service in holding the fire in check.

4519. Primary supply gravity tank. Second supply 500 gallon steam pump. Fire was in attic where water pressure was very light from tank and pump was used and was of service, but owing to poor sprinkler system and construction the fire was not controlled by the sprinklers.

5532. Primary supply water works, eighteen pounds pressure. Second supply 6,000 gallon gravity tank, third supply 750 gallon steam pump. Fifty-three sprinklers opened and water was used from all supplies. The pump was undoubtedly of considerable assistance in holding fire in check.

5993. Primary supply automatic steam pump. Second supply large gravity tank. Twenty-two sprinklers opened and were fed by automatic pump but 15,000 gallons of water were also used from gravity tank. It would seem that the tank was of some service in helping to afford a liberal supply for the sprinklers.

14. EFFICIENCY OF WATER SUPPLIES.

Primary Water Supply.	Number of fires	Per cent. of fires	Average Pressure	Average number Spkrs. opened	Per Cent. of Fires. Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Average Pressure. Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Average Number Sprinklers Opened. Extinguished fire (or practically extinguished)	Held fire in check
Water works,	73	60	56	14.9	78	19	3	59	44	60	14.8	17.5
Gravity tank,	16	13	22	7.0	50	44	6	24	21	8	5.1	10.2
Pressure tank,	19	16	84	9.0	84	16	0	85	77	0	9.0	9.3
Automatic pump,	14	11	66	11.9	43	57	0	85	52	0	3.8	18.0
Total,	122		57	12.7	71	26	2	62	44	43	12.1	15.3

15. EFFICIENCY OF WATER PRESSURES.

Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average Pressure	Average number Spkrs. opened	Per Cent. of Fires. Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Average Pressure. Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Average Number Sprinklers Opened. Extinguished fire (or practically extinguished)	Held fire in check
Less than 15 lbs.,	4	3	11	2.7	25	50	25	10	12	8	6.0	2.5
15 to 24 lbs. inclusive,	8	7	20	16.0	37	63	0	20	20	0	4.7	22.8
25 to 49 lbs. inclusive,	46	38	38	11.2	70	30	0	38	37	0	12.4	8.2
50 lbs. and over,	64	52	78	13.9	80	17	3	80	69	60	12.5	23.2
Total,	122		57	12.7	71	26	2	62	44	43	12.1	15.3

16. EFFICIENCY OF WET OR DRY SYSTEM.

Wet or Dry System.	Number of fires	Per cent. of fires	Average Pressure	Average number Spkrs. opened	Per Cent. of Fires. Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Average Pressure. Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Average Number Sprinklers Opened. Extinguished fire (or practically extinguished)	Held fire in check
Wet system,	65	53	51	5.8	66	31	3	56	41	37	4.0	9.9
Dry system,	57	47	64	20.5	77	21	2	68	49	55	19.9	24.2
Total,	122		57	12.7	71	26	2	62	44	43	12.1	15.3

Note—"Average number of sprinklers opened" does not in any case include the Unsatisfactory fires.

17. EFFICIENCY OF WATER SUPPLIES. As Regards Amount of Loss.

Primary Water Supply.	Number of fires	Per cent. of fires	Average Pressure	Av. No. Spkrs. opened	Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened.		
					No claim	Small loss	Large loss	No claim	Small loss	Large loss	No claim	Small loss	Large loss
Water works,	73	60	56	14.9	59	33	8	54	60	52	15.3	16.0	12.2
Gravity tank,	16	13	22	7.0	25	56	19	23	23	15	2.3	11.2	1.5
Pressure tank,	19	16	84	9.0	95	5	0	85	70	0	9.3	5.0	.0
Automatic pump,	14	11	66	11.9	36	29	36	87	68	44	2.0	6.3	26.4
Total,	122		57	12.7	57	31	11	62	52	41	12.1	13.6	16.7

18. EFFICIENCY OF WATER PRESSURES. As Regards Amount of Loss.

Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average Pressure	Av. No. Spkrs. opened	Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened.		
					No claim	Small loss	Large loss	No claim	Small loss	Large loss	No claim	Small loss	Large loss
Less than 15 lbs.,	4	3	11	2.7	0	50	50	0	10	11	.0	4.5	1.0
15 to 24 lbs, inclusive,	8	7	20	16.0	25	63	12	20	20	24	3.5	24.0	1.0
25 to 49 lbs. inclusive,	46	38	38	11.2	59	30	11	40	36	37	12.9	4.7	19.8
50 lbs. and over,	64	52	78	13.9	64	27	9	79	81	58	11.9	18.8	20.5
Total,	122		57	12.7	57	31	11	62	52	41	12.1	13.6	16 7

19. EFFICIENCY OF WET OR DRY SYSTEM. As Regards Amount of Loss.

Wet or Dry System.	Number of fires	Per cent. of fires	Average Pressure	Av. No. Spkrs. opened	Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened.		
					No claim	Small loss	Large loss	No claim	Small loss	Large loss	No claim	Small loss	Large loss
Wet system,	65	53	51	5.8	48	37	15	60	44	41	3.4	6.3	15.0
Dry system,	57	47	64	20.5	68	24	7	65	68	43	19.0	26.0	21.3
Total,	122		57	12.7	57	31	11	62	52	41	12.1	13.6	16.7

Note—"Average number of sprinklers opened" does not in any case include the Unsatisfactory fires.

General Fire Record.

FIRE-PROOF BUILDINGS FIRE RECORD.

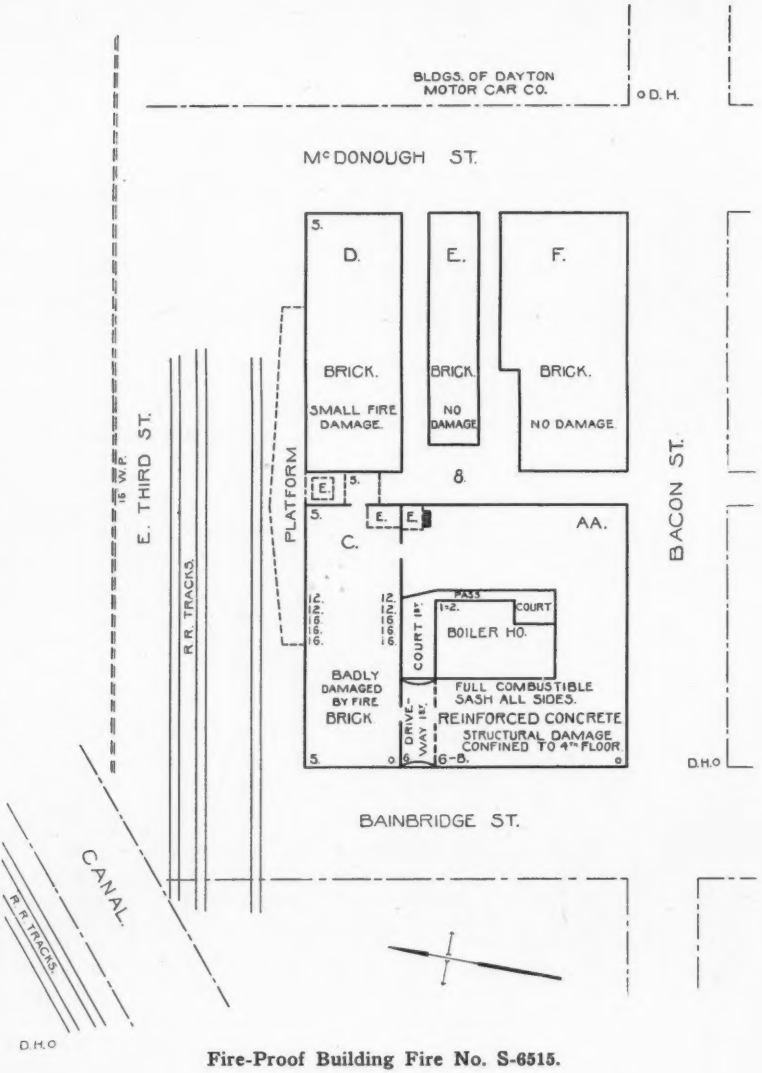
S-6515. Dayton, Ohio. February 21, 1908. Automobile Factory. Building in which the fire occurred is the newly constructed monolithic reinforced concrete construction, six stories high, known as building "AA." It adjoined and communicated through unprotected openings with the five-story brick building "C" of ordinary construction. The concrete building was of pier, curtain wall construction.

Piers in basement, 25x25 inches square and spaced 22-foot centers; bays supported by same class of girders spaced seven-foot centers, 9x11 inches; beams from piers, 12x17 inches. The piers decrease in cross section, until at roof (or sixth floor) they are 12x12 inches, except under foundation for sprinkler tank, where they are 19½x19½ inches. Roof of same class of construction, but with lighter structural members. Floors of monolithic, reinforced concrete construction, supported on the beams and girders as set forth above. Wood floor on first attached to wood nailing strips laid in concrete, same devices used for giving initial supports to wood running boards to attach electrical wires.

Between each outside pier, both in exterior and area walls, there is a four-inch concrete curtain wall extending about three feet from floor; on this rest ordinary, light, wood sash and thin glass, making a very large area of this inferior class of construction.

One large open elevator and one stairway at same point. The fourth floor where the fire started was occupied as upholstering and trimming also storage of motor cars. Fifth floor was painting department and this floor was practically vacant. Fire was discovered by outsider at 12.45 a. m. and was first noticed about midway on the west side. The occupancy made a hot quick fire which spread rapidly throughout this portion of the floor and through the unprotected openings into building "C" which latter building was practically destroyed except the walls. The fire department helped keep the fire from spreading to "D" and also helped confine it largely to the fourth floor of "AA." Building "AA" was being equipped with sprinklers and the work was nearly completed.

"The only floor on which fire gained a foothold was the fourth, where it originated. The mass of combustible material therein was sufficient in section marked with X on diagram to spoil the concrete covering on one pier and numerous girders. The concrete has fallen off some of the girders, on lower edges, exposing the metal reinforcement. The action of the heat has calcined the concrete to such an extent as to make some of the girders defective against another attack. Our inspectors do not consider the integrity of the supports impaired against ability to sustain load, but only against fire. There was scarcely five-sevenths of an inch of concrete about bottom of the reinforcing members; totally inadequate and not in accord with best practices.



Fire-Proof Building Fire No. S-6515.

"The heat caused about two inches of the concrete floor to disintegrate and in one instance, directly above hottest part of fire, the action extended to and through ceiling of the fourth, showing on the fifth floor.

Fire-Proof Building Fire No. S-6515.

Fire-Proof Building Fire No. S-6515.

Fourth Floor Building "AA."

Note approximate location of start of fire. Note condition of concrete beams and girders. Note result of high temperature on sprinkler and heating pipes. All wood sash on this floor destroyed. Floor disintegrated to distance of 2½ inches. Floors not arranged for flooding. Integrity of structure not impaired for sustaining weight.

"The mass of combustible material on which flames fed, was comparatively small; had the fire been long sustained, as in a general conflagration, the concrete structure would have failed and one floor would have wrecked the one beneath.

"Fire in the concrete structure was spread to fifth by means of flames from fourth floor igniting the light and flimsy wood sash; same cause tended to spread it to the lower floors, as the burning sash dropped on the roof of the one equal two-story boiler house and set fire to the sash on the second and third floors. Members of the firm and firemen prevented fire getting a foothold, however, the damage being confined to the sash on third, some few being burned out, all sash on the fourth and some on the fifth. Small wood partition about a toilet room on the fifth; this was ignited through the unprotected opening from division 'C.' There being but little stock on fifth floor, there was practically nothing to sustain combustion. Damage to the concrete structure amounts to nothing on this floor. Fire not securing any hold on stock in this building, except on the fourth, the damage to the building is confined entirely to that floor, with the exception of the wood sash on the others.

"Water seeped through the concrete floor and about the risers for both the steam heating and the sprinkler system and damaged stock more or less on every floor. The sewer becoming clogged, water stood ten inches deep in the basement and wood bodies of motor cars were somewhat damaged.

"The fire did not enter that portion of the structure where elevator was situated, therefore, this prolific source of communicating fire from floor to floor did not act as it generally does.

"Remarks. Assured had previously been advised by inspector a number of times to protect the communicating openings leading from division 'C' to 'AA', but neglected taking any action; also to enclose the elevator with incombustible walls fitted with rolling curtain. Had the openings been protected, even with a single fire door, it would have given the weak sprinkler equipment behind them a good chance to operate successfully. The addition of pine or other combustible partitions in a fire resisting building is condemned, also combustible sash. Fire may easily spread from floor to floor through this means.

"Watchman service had not been extended to the new building; management states that watchmen were instructed to make rounds, but although there were three watchmen they did not discover the fire, which was detected and alarm sent by an outsider."

H-2374. New York, N. Y. March 10, 1908. Clothing Factory. Fire started in a six-story brick mercantile building of ordinary construction occupied by a cloak and suit manufacturer. Fire spread very rapidly and building was completely gutted. Adjoining this building and extending above it was a new twelve-story fire-proof building of steel skeleton construction, brick walls, terra cotta floors and fireproofing. Floor openings in this building were cut off by 4-inch terra cotta partitions with doors of stamped metal with upper panels of wired glass, hung with butt hinges. All window openings except those on the street front, including those above the building which burned were of single wired glass one-quarter inch thick, set in

hollow metal sash and frame, lower sash stationary, upper sash pivoted and provided with automatic attachment.

The fire lapped around the front of the building entering the windows on several of the floors and igniting the contents. Basement and sixth floor were vacant and therefore little damage done except to the windows and sash. The upper floors were occupied chiefly for clothing manufacturing, the chief damage being on the seventh, eighth and tenth floors. The two upper floors seem to have escaped partly because they were sufficiently high above the adjoining fire. The wired glass windows prevented the fire from entering on the sides protected. The floor openings prevented the fire from spreading from one floor to another although some of the wired glass panels failed and the kalameine doors were seriously damaged, the inspector's conclusion as to these doors being that they did not as ordinarily made and hung show a high degree of resistance to severe heat.

This fire shows the necessity of wired glass windows on street front as well as on sides, the evidence being conclusive that the flames from the adjacent building were swept around to the front of the fireproof building and entered the unprotected windows.

UNSATISFACTORY OR SERIOUS FIRES IN RISKS EQUIPPED WITH SPRINKLERS.

6549. Cateechee, S. C. January 2, 1908. Cotton Warehouse. Two-compartment, three-story, standard warehouse. Each section 52x54 feet. Fire occurred at night and was discovered by watchman. Building was equipped with Grinnell glass disc sprinklers, 30 on each floor. Old standard spacing and arrangement. Wet system supplied by a 50,000 gallon reservoir giving about 18 pounds pressure on sprinklers and a 1,000 gallon rotary pump. There was an open hatchway eight foot square through which the fire quickly spread to all floors and this overloaded the three-inch riser. Line of three sprinklers had been disconnected on second floor leaving one bay between hatchway and side of building unprotected. Loss about $35,000.

Summary: Floor openings.

6239. Wilmington, N. C. February 8, 1908. Saw Mill. Two-story open joist frame construction. Second floor about 25 feet high in the center. Fire apparently started at main bearing of band saw due to friction. Fire spread rapidly and sprinklers failed to hold it in check and loss was practically total. Risk was equipped with Grinnell glass disc sprinklers, 150 on each floor. Dry pipe system. Old standard spacing and pipe sizes. Primary supply from large gravity tank, second supply steam pump. Sprinklers apparently opened promptly. There were the usual obstructions to distribution from housing and chutes.

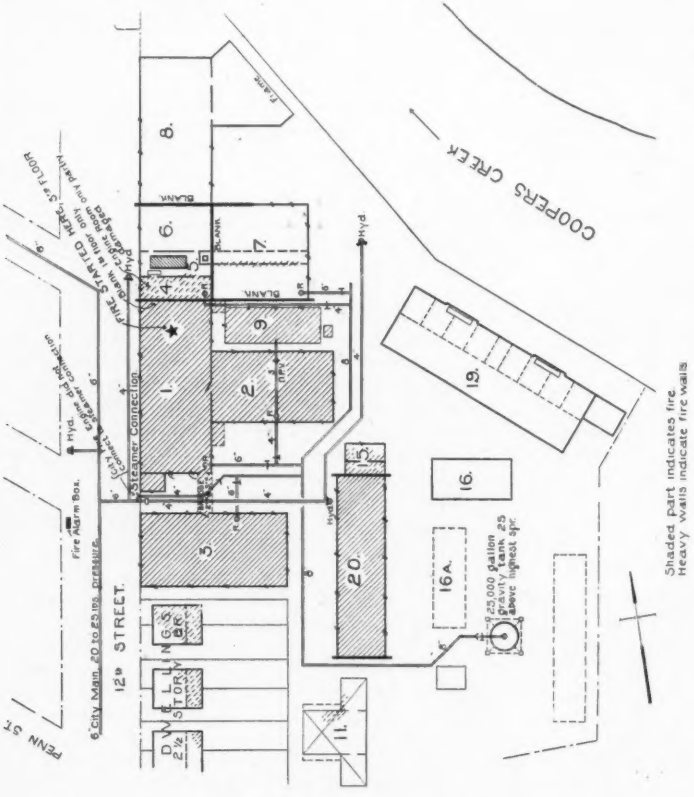
The unsatisfactory work of the sprinklers may be assigned to the rapid spread of fire, inflammable nature of building and stock and high ceiling with open end. Loss about $100,000.

Summary: Poor construction and high roof.

6516. Lowell, Mass. February 10, 1908. Cotton Mill. Fire started in hollow roof of attic of No. 3 mill. It originated in back of the wood sheathing. This was a pitch roof wood sheathed with blind attic. The sprinklers were of little or no use as the fire burned back of the sheathing and as the sheathing burned through the sprinkler pipes gave way. About 80 sprinklers in all opened and fire was finally controlled by fire department and private hose, the roof being practically destroyed. Loss will be about $25,000, being largely water damage to machinery and stock.

Summary: Concealed space.

6544. Camden, N. J. February 17, 1908. Varnish Works. Brick buildings one to three stories high. Fire started on third floor of No. 1. Open joist construction. This floor was used for storing



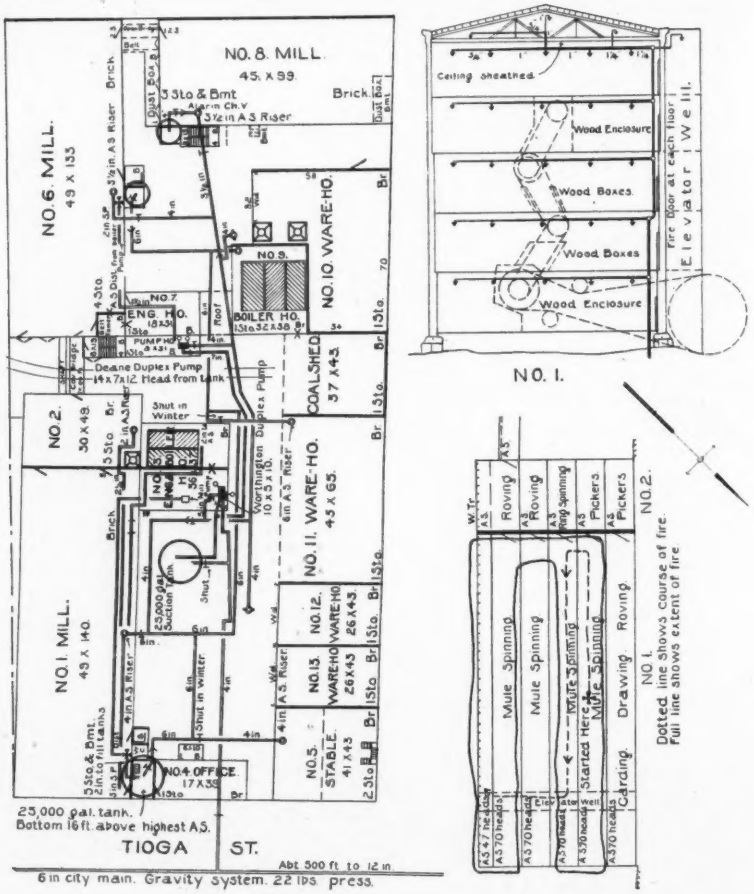
Sprinkler Fire No. 6544.

varnish in tanks and at time of fire workman was filling one of the varnish tanks from a hose, the varnish being pumped hot from the mixing room in No. 7. There was a quick flash fire at the tank, the exact cause being unknown. There was no lighting, electric wires or other reasonable cause. The varnish was low grade with benzine and turpentine used as solvents. Tanks were of metal with thin metal covers. Building was equipped with International sprinklers. Wet system, supplied by a 25,000 gallon gravity tank giving about 25 pounds pressure on the sprinklers where fire started. The only other supply was a steamer connection which was not used.

The quick flash fire probably opened up most of the sprinklers in the room, there being something over 80 in all. It appears that the sprinklers had considerable effect on the fire and held it in check for about half an hour which exhausted the tank supply. Soon after this the third floor of No. 1 collapsed and the fire quickly spread to No. 2 and No. 3. The fire department had responded before this, aided by one of the fire boats, but owing to the intensity of the fire they could do little towards saving the plant. Later fire spread to building No. 9, which was of frame construction, and building No. 20 which was two-story brick occupied for storage. The blank wall between No. 1 and No. 4 and between No. 9 and No. 7 saved the buildings to the north. The fire doors between Nos. 1, 2 and 3, were of little value because of the unprotected windows. The heavy loads on the light and poorly constructed joist floors caused early collapse. It appears quite possible that had the gravity tank supply been reinforced by an adequate pump supply the fire might have been checked in the room where it started.

Summary: Hazard too severe for sprinkler system as installed.

6564. Philadelphia, Pa. February 20, 1908. Cotton Yarn Mill. Five-story brick building with mill constructed floors, wooden trussed joist roof, occupied as a cotton yarn mill. Fire started in second floor used for mule spinning, caused probably by defective electric wires. Burning cotton dropped on the mule carriage. Employee tried to extinguish fire with pails of water and small hose. Risk was equipped with Walworth pendant sprinklers, old standard spacing and pipe sizes. Wet system supplied by tanks of total capacity of 37,000 gallons connected to sprinklers only. Second supply two steam pumps with a combined capacity of 750 gallons. These were connected to both the sprinklers and yard hydrants. Pumps take suction from a 25,000 gallon cistern and also direct from city mains through a four-inch connection. Although it appears that at least some of the sprinklers opened promptly they failed for some reason to hold the fire in check and they may have been slow in operation. The fire spread through the second floor and about that time the fire department arrived. Fire spread through belt openings into third floor and also spread into elevator tower through a defective fire door poorly hung. It then spread up the elevator tower into the fifth story and also into the cock loft or attic there being an unprotected opening into the latter through the elevator tower. In all 257 sprinklers opened and the fire was finally controlled by the fire department after having extended and burned out the second, third and fifth stories and roof.



Sprinkler Fire No. 6564.

It is stated that both pumps were started soon after the alarm was given but they were used for hose streams and were of little if any service to the sprinklers. Furthermore the steamers took away the pressure from the mains so that there was no water to feed the boilers and the pumps had to be shut down in the early stages of the fire.

The tanks were probably emptied at about the same time so that after the first hour or less the private fire protection was of no value.

To conclude, it would seem that the sprinklers could not have

operated promptly and with ordinary efficiency for otherwise the fire should have been controlled if not entirely extinguished at the outset. If the pump had been used for sprinklers only the result might have been different. Furthermore, floor openings played an important part in the spread of the fire.

Summary: Probably defective sprinklers.

Note.—Another report states that some of the sprinklers on the second floor were plugged with mud and sediment and this may have had some influence on their effect.

6515. Dayton, Ohio. February 21, 1908. Automobile Factory. (For further details see report on fire in Fire-Proof Buildings.) Fire started on fourth floor of reinforced concrete building and spread through unprotected openings to five-story brick building. The sprinklers in the concrete building were not in service and the system in the brick building was old and more or less obsolete, being a one-supply Grinnell metal disc sprinkler with old style spacing and arrangement. The fire had obtained such headway in the unsprinklered floor that the weak sprinkler system was unable to cope with it.

Summary: Unsprinklered portions.

6499. Minneapolis, Minn. February 22, 1908. Pail Factory. Large frame factory. The fire started in south section second story and was discovered by watchman. The sprinkler system in this sec-

Sprinkler Fire No. 6499.

tion of the building was shut off for some unknown reason. The sprinklers in the north section were in service and with the aid of the fire department this end of the building was saved.

Summary: Water shut off.

LARGE LOSS SPRINKLER FIRES.

Where Sprinkler Control is Satisfactory.

6273. Scranton, Pa. May 3, 1907. F. P. Knitting Mill. Fire occurred in card room on third floor. Mill construction. Quick flash fire opened up 65 heads. Walworth old type sprinklers ten feet apart. Wet system, supplied by city water 80 pounds pressure. There was a fire pump but it was not needed. While the sprinklers held fire in check the ceiling was damaged considerably and it is possible that the sprinklers were slow in operating as well as giving inferior distribution. Loss about $30,000.

Summary: Old style sprinklers.

6438. College Point, N. Y. January 17, 1908. Paint Factory. Fire occurred on second floor of open joist brick building occupied for paint grinding. Five sprinklers opened and held fire in check. There was a tank of oil containing about a barrel near grinding machine where fire started, this ignited and made fire somewhat difficult to extinguish. Loss about $8,000.

Summary: Oil fire difficult to extinguish.

6384. New York, N. Y. January 21, 1908. Tenant Manufacturing. Fire occurred on second floor in a room occupied for wholesale furniture storage. Ordinary open joist construction with brick walls. Room was stocked with mattresses and furniture ready for shipment. Cause unknown. There were six sprinklers in the room and all opened and held fire in check. Owing to obstruction to distribution fire was not entirely extinguished and the fire department had to cut holes in the floor above. Considerable water damage. Loss about $9,000.

Summary: Obstruction to distribution.

6419. Philadelphia, Pa. February 1, 1908. Weave Mill. Fire occurred in first floor occupied for manufacturing of woolen shawls from yarn. Cause unknown. Fire was discovered by employee when he came to work at 6.15 a. m., watchman having failed to discover it. Brick walls, open joist construction. Risk equipped with Walworth ordinary 1896 sprinklers, ten feet across joists in eight-foot bays. Wet system. Gravity tank the only supply giving 25 pounds pressure on the sprinklers. Thirty-eight heads opened and held fire in check. Loss about $5,000.

Summary: Probably slow operation of unapproved sprinklers.

MISCELLANEOUS FIRES.

H-2369. Elmira, N. Y. November 26, 1907. Printing Establishment. The 12-16-inch blank wall, together with the two-inch single tin clad sliding automatic fire doors, kept the fire entirely out of the main sprinklered plant, although the door on the third floor was burned and the tin sheets badly warped. The recessed handle on this door was fastened by screws instead of bolts; these dropped out and allowed the fire access to the wooden interior of fire door, which was charred through at this point.

The fire seemed hottest at this point and was only prevented from gaining access to main plant by the effective work of employees in keeping door cooled by pails of water.

The stone sill at this door was flush with the wall, and the flooring in main risk under door was charred, and had the fire continued much longer it might have entered risk at this point by the breaking down of this single fire door.

H-2483. Indianapolis, Ind. January 29, 1908. Warehouse.

Cut 1. Showing the interior of Sections D and E and some of the fire doors in the division walls. Taken from near the front of the third floor of Section D. Note the effect of fire on the hinged fire doors, warping due to side center latch, an approved practice.

Cut 2. Another view of the interior of Sections D and E. Taken from the rear of the fifth floor of Section E.

Cut 3. Showing the fire doors on the wall between Sections A and D. Both doors on the opening marked **X** were destroyed by the intense heat. The brick work seems to indicate that the heat was the most intense at this point. The corrugated doors are the elevator doors. The small doors are at the stair landings.

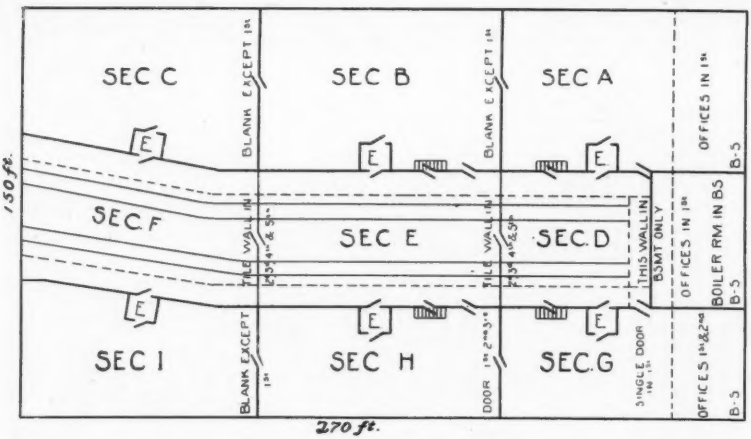
Cut 4. Showing the fire doors on the wall between Sections D and G. This view shows that the automatic door on the fifth floor closed half way, and the one on the fourth floor failed to close at all.

The girder holes shown in the wall at the left of these doors and marked **X, X, X,** extend entirely through the wall without any intervening brick partition. It was undoubtedly through these holes that the fire gained access to the upper floors of Section D, particularly through the one in the second floor, directly under those shown.

Cut 5. Showing that portion of the interior of the boiler room directly in front of the boiler. The heavy girder and the cast-iron post support the wall in the rear of the Warehouse Co.'s office. The metal clad portion of the ceiling is directly under the offices; the portion between the girder and the wall marked **X** is the platform shown in Cut 6, the window shown here being the same one shown at the right of the car bumper in Cut 6. The wood in which the fire started was piled in the space marked **X.** Two ash piles are shown, one on either side of the space marked **X.** It will be seen that the ceiling under the platform and the cracks between the planks are badly charred, and the insulation on the steam pipe destroyed.

Cut 6. Showing the rear of the Warehouse Co.'s offices, the platform over the rear of the boiler room, the end of the railway track, the boxes to which the fire from the boiler room was communicated and the door, marked **X,** against the other side of which the paper oyster pails were piled.

Five-story and basement brick warehouse building cut off in nine sections. See sketch. Outer and inner walls, including elevator shafts, were brick, ranging from 20 to 12 inches thick, corbelled to support the floors, and parapeted, except the walls between D and E, and E and F, which were six-inch hollow tile from the second to the fifth floors not extending through the roof. All openings in walls were protected by double automatic metal clad doors except that the openings on the first floor from the side to the middle sections were protected by single corrugated steel rolling doors. This type also being used for doors on both sides of elevator shaft. Metal clad doors were



Miscellaneous Fire No. H-2483.

two-ply one-inch boards, standard covering, hung on inclined tracks and fitted with fusible links. A few of these doors failed to close at time of fire although the links fused. Some of them were entirely consumed. (See cuts.)

The front half of the first floor D was 4-inch pine with board top. Other floors throughout were of pine joists laid on edge, spiked together with board top making exceptionally heavy construction.

Stairways enclosed by 7/8-inch matched board partitions except one in first floor section G, open from first to second.

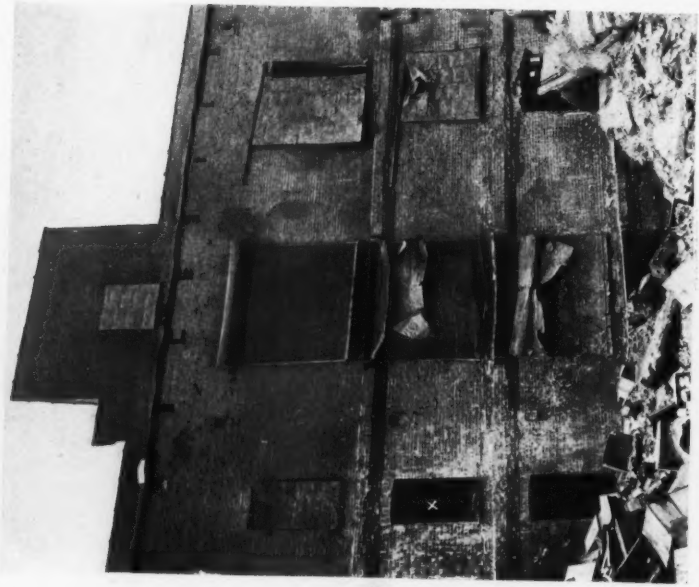
Fire started in boiler room spreading over the ceiling, then up through cracks in the ceiling, part of which was a shipping platform, igniting boxes above. The heat from these boxes passed through the rolling steel door igniting paper piled on the other side. Fire then spread to small dumb-waiter half way across the room burning up the outside and finally into the dumb-waiter itself, thus gaining access to the second floor. At the top of the post in the second floor against which the dumb-waiter was built the fire burned through to the third floor. Fire also followed along the ceiling on the second floor back to the division wall following the girder through the wall, as the opening made for the girder to rest in extended clear through without intervening brick work. This allowed fire to spread from section G back into section D. The fire in D was so intense that the fire doors on both sides of the wall between A and D were destroyed on fourth floor giving the fire access to section A. The tile wall between sections D and E failed on the fourth and fifth floors and the fire also followed the roof, burning the roof off of section F.

Section G was occupied for storing paper. Section D the same above the first story. Section A mostly canned goods. Fire destroyed or badly damaged section G, above second; A, above fourth;

Cut No. 1.

Cut No. 2.

Cut No. 4.



Cut No. 3.

Cut No. 5.

Cut No. 6.

D, above second; E, above third; and the roof on section F. Heavy water damage on some of the floors below those burned.

The cut-offs were entirely effective in preventing fire from entering B, C, H and I. The outside protection seems to have been good and all that might reasonably have been expected, the fire apparently having obtained considerable headway before being discovered.

The following is quoted from a report on this fire:

"This fire has again demonstrated the unreliability of rolling steel doors as a fire retardant,—the necessity of standard fire doors on both sides of openings in wall,—that girders, as well as floor beams, should be carried on corbells or pilasters, or should have at least eight inches of brick between ends of timbers, when the latter are inserted in walls, —that openings in fire walls above roof for purposes of drainage nullify the value of such walls as fire cut-offs,—that all floors in buildings of this and other good types of construction should be provided with scuppers of ample capacity,—the necessity of metal flashings at floors around posts and at walls,—and last but not least, that buildings of so-called full mill construction burn almost as readily as buildings of inferior design, and that all risks similar to this should be provided with sprinkler equipments. Stock should not be piled in front of windows, and never within 24 inches of wire glass windows. This and our past experience has clearly shown the necessity for the devolpment of a more efficient type of fire door."

H-2368. Portland, Maine. January 28, 1908. Mercantile Building. (Wholesale.) Two adjoining buildings about 150 feet deep by 45 feet front. Basement and four stories. High brick walls with mansard roof, slate covered. Floors double board on joists. Lath and plaster finish. Stairs shut off and elevators trapped. The two buildings were separated from each other by a blank brick wall 16 inches thick on the first floor and 12 inches above with a 12-inch parapet extending two and one-half feet above the roof. This parapet was extended to cut off the mansard roof. The building on the south occupied as wholesale dry goods was destroyed. Fire did not communicate to the north building until the roof collapsed which pulled over a portion of the 12-inch fire wall allowing the fire to spread to the north building occupied as a wholesale boot and shoe warehouse.

It appears that the roof joists were tied through the wall to the joists on either side by one and one-quarter inch iron bands and the joists on either side extended four inches into the wall on the third floor. The third and fourth floors of the north building are entirely gone. This fire illustrates the undesirability of weak party walls with joists entering same and tied from one side to the other.

H-2366. Philadelphia, Pa. February 5, 1908. Chemical Storehouse. This fire occurred in an old one and one-half story brick structure, 20x25, formerly occupied as a junk shop, and was leased by a storage company for the storage of dangerous chemicals. The laws of our city require that such substances must be kept in a building not used for any other purpose. The contents consisted of chlorates of potash and soda, and saltpetre, all of the same properties (oxidizers). The building was surrounded by other old structures of little importance.

The fire occurred while the building was closed. Across the street are a number of old dwellings and the occupants were awakened by a hissing sound attending a fierce fire, which soon blew out the windows and openings of the warehouse. Repeated explosions followed with varied force and noise, which could be heard several blocks away. Fortunately, the roof was broken by one of the first explosions, which afforded a vent directing the effect of the explosions upward. The explosions and intense heat deterred the firemen from fighting the fire at close range, and their efforts were directed to the surroundings. The list of contents called for 310 kegs in the whole, which were all stored on the first floor.

Explosions during combustion among chlorates or nitrates whereever present are to be expected when from combustion with the wood of the kegs alone; the result being the evolving of immense volumes of oxygen from the salts, producing rapid combustion and where bodies of smoke arise intermittingly, an explosive mixture is formed by the heated oxygen with the gases and unburned carbon in the smoke. The violence of the detonations depends on the proportions of oxygen and other gases. The firemen stated that the water at times seemed to add to the explosions. This latter effect results from water in the form of spray being thrown on such a fire; the heat being so intense as to cause decomposition of the water with sharp explosive effect. The fire lasted but a short time and the combustion was so complete that the adjusters of the insurance loss were unable to find even a stave, head, or bottom of any of the 310 kegs. The floor supports were nearly burned away and the face of the bricks on the inner side of the wall were burned off as like a crumbling effect.

The most fortunate conditions with this fire was the fact of the weak construction and area of the structure together with the rupture of the roof at the beginning of the fire.

The origin of the fire is a mystery. There were no acids or sulphur in the listed contents, or other substances which if attacked with leakage of water or rain might develop heat. There was no traffic in the building, it being opened only to receive and discharge packages. The doors and other openings were poorly secured and the locality being dark and of little traffic afforded chance for setting fire to the structure. Loss on contents, $3,500.

Notes and Tables.

TESTS OF CELLULOID.

Samples of celluloid were received for test from the Celluloid Company, Newark, N. J. The object of the test was to determine accurately the ignition point of this concern's product, as the information at hand on the point in question seems to vary considerably.

There were four kinds of celluloid sent in as follows, the sheets being 10x6 inches and unpolished except as noted:

No. 1. Milk white 9-64 inch thick; weight, 1 pound per square foot.

No. 2. Orange colored, 11-64 inch thick; weight, 1.2 pounds per square foot.

No. 3. Tortoise shell pattern, 5-32 inch thick; weight, 1.1 pounds per square foot.

No. 4. Transparent polished on one side. Sheets about as thick as heavy wrapping paper.

For the first test samples were cut from these sheets, three inches square with a 7/8-inch hole in the centre as shown in Figure 1. Each sample contained 8.4 square inches and those cut from sheets Numbers 1, 2 and 3 weighed about one ounce. In order to make the tests as accurate as possible the thermometer bulb was located in the centre of the orifice (Figure 2).

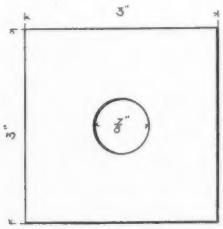


Fig 1.

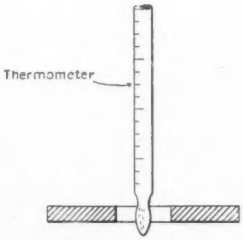


Fig. 2.

The celluloid was supported on fine copper wire in the centre of an oven which is about one foot square. The oven is double walled and heated by an ordinary Bunson burner burning city gas. Size of oven about one foot cube.

The same flame was used throughout the oven tests to insure uniformity. Readings were taken every minute at first, then every half minute, the rate of heating being about as follows:

2 minutes	185°
3 minutes	210°
4 minutes	230°
5 minutes	240°
6 minutes	240°
7 minutes	258°
8 minutes	266°
9 minutes	274°
10 minutes	280°
11 minutes	286°
12 minutes	292°
13 minutes	298°
14 minutes	303°
15 minutes	305°
16 minutes	307°
17 minutes	308°
20 minutes	310°

Temperatures were observed on a specially sensitive, calibrated Lloyd thermometer reading to 700°.

Test No. 1.	White piece.	Flashed at 305°
Test No. 2.	White piece.	Flashed at 293°
Test No. 3.	Orange piece.	Flashed at 303°
Test No. 4.	Orange piece.	Flashed at 304°
Test No. 5.	Tortoise shell piece.	Flashed at 286°
Test No. 6.	Tortoise shell piece.	Flashed at 285°
Test No. 7.	Thin piece	Flashed at 285°
Test No. 8.	Thin piece.	Flashed at 309°

Note.—In No. 2 the celluloid was supported on cord instead of wire to note whether the wire had a tendency to hasten the burning point. As it appeared to make no difference, the cord was not again used.

We believe that the combinations of the form of the pieces and the location of the thermometer bulb together with the slow and uniform rise of temperature maintained gave results as accurate as could possibly be obtained with ordinary apparatus.

The following tests were made to determine the effect of varying the conditions. In these tests strips of celluloid 3x1 inch were used. They were located at the same point in the oven as in previous tests, but the thermometer in Nos. 9 and 10 was located about one inch above and directly over them. In No. 11 the thermometer was three inches away and one inch above the sample.

Test No. 9.	Thin piece.	Flashed at 292°
Test No. 10.	Orange piece.	Flashed at 322°
Test No. 11.	White piece.	Flashed at 350°

The two latter tests show that a little higher reading was obtained with the thermometer higher than before, which points out the value of

the previous tests where the thermometer bulb was located exactly in the centre of the sample.

Test No. 9 did not indicate anything special. This thin celluloid curled up considerably when heated, in all tests, so the exact relation between the sample and the thermometer could not be maintained.

The following tests were made in the sprinkler oven. This oven gives a more intense heat than the first one used and the heat is in the form of a vertical current of hot air, whereas in the former oven the hot air bath was practically quiet.

The rate of increase in temperature in the sprinkler oven was much greater than in the first oven and was as follows:

1 minute 240° 1½ minutes 290° 2 minutes 320°
2½ minutes 350° 3 minutes 365° 3½ minutes 375°

The samples tested were hung on a wire in the center of the oven with the thermometer bulb level with their centers and about one inch distant. Samples were 1½x1 inch.

Test No. 12. White piece. Started to burn without flame, but stopped again at 335°. At 360° entire sample burned without flame, the gases being carried out of the oven by the regular air current.

Test No. 13. Orange piece. Started to burn without flame at 356°, but burning did not continue. Same at 370°. Burned with flame at 378°.

Test No. 14. Tortoise shell piece. Burst into flame at 345°.

Test No. 15. Thin piece. Burned up without flame at 280°.

These tests show the effect of the rapid rate of heating on the thermometer readings. No. 15 being a very thin sample was probably hotter than indicated on the thermometer or in other words was more sensitive to the heat than was the thermometer. Nos. 13 and 14 were thick samples and probably did not get thoroughly heated to the point observed so that the thermometer was more sensitive than the samples. These inaccuracies were practically done away with in tests Nos. 1—9.

Conclusions.

1. The product of the Celluloid Company can be expected to ignite at a temperature around 300° F.

2. In testing for the burning points the importance of gradual heating and accurately measuring the exact temperatures on the surface of the sample is brought out.

BENJAMIN RICHARDS, *Inspector.*
The Underwriters' Bureau of New England.

February 27, 1908.

EXPLOSION OF SOLDERING GAS SYSTEM.

In a Jewelry Factory at North Attleboro, Mass.

General Description of Jewelry Shop Gas Soldering System.—This soldering system is common to nearly all jewelry shops and consists of two systems of piping which extend throughout the plant where soldering, annealing or bench work is done. One system of piping

carries the gas (in this case public coal gas) and is ordinary wrought-iron gas piping. The other system carries the air under slight pressure and is made of sheet-metal (tin) soldered. The air and gas piping come together at the burner which is of various forms but all having the same general principle, i. e., the air furnishes the blast or draft for the gas flame. Both gas and air are regulated by cocks at each individual burner.

System Which Exploded.—The system in which explosion occurred was of same general description as given above. The pipe supplying the gas to building is 2½ inches in size with a shut off valve where it enters the basement, controlling all gas supply to the building except a one-inch connection supplying office and power room lights. Air blast is supplied by American Gas Furnace Co., high pressure blower driven by belt and also located in basement. Air pipe where it leaves the blower is five inches in diameter. Both air and gas pipe gradually reduce in size as they extend throughout the building to each individual burner.

Damage Done by Explosion.—Damage done by explosion was not extensive. Several (probably 50) panes of glass were blown out and a considerable amount (probably 50 running feet) of the tin air blast piping was burst open and in some cases torn away. No fire occurred, no one was hurt and no claim is made under the fire insurance policies.

Probable Cause of the Explosion.—Explosion occurred in the afternoon of January 2, 1908, a short time after the factory had closed down for the day. It is probable that an employee upon quitting work left his or her gas soldering flame burning and when blower was shut down the flame and gas may have drawn back into the air blast piping, and an explosive mixture formed with the resultant explosion. Although search was made after the explosion, no gas burner was found which had not been shut off. Exact location of the causes cannot be determined as pipe burst in several places throughout the system.

It appears that similar explosions although not of so violent a nature are quite common in these systems. Among the jewelry manufacturers consulted no case was known where such an explosion had caused fire, although it seems probable that such a result might reasonably be expected.

Precautions.—Shut off main supply of gas to the entire system before shutting down the blower (now done at this shop). Provide auto puppet valves at intervals throughout the main blower piping, which opens when blower is shut down and thereby releases any gas which may possibly be drawn back into air piping system. Install Gilbert & Barker Springfield Fire Arresters or similar device in the air piping system preferably at each burner.

The Underwriters' Bureau of New England.

February, 1908.

CONDUCTIVITY OF HOSE STREAMS.

It is pretty generally believed that considerable risk to life is involved in putting a hose stream on a 2,000-volt wire. Last summer I made a few experiments along this line which may be of interest to some of your readers.

I used a current of a potential of 3,500 volts. One side of the circuit was connected to a loop of No. 12 bare copper wire about two inches in diameter. The other side was connected to the underground water pipes. Fifty feet of two and one-half inch cotton rubber-lined hose was attached to a hydrant, and provided with a standard one and one-eighth inch brass nozzle. The water was throttled down so as to make a continuous and nearly solid stream. The end of the nozzle was fastened in porcelain cleats 12 feet from the loop of copper wire. On the floor near the nozzle was placed a sheet of lead in metallic connection with the water pipe system.

Having first poured water on the sheet of lead to insure good contact I stood upon it with my bare feet and grasped the nozzle firmly with both hands, my hands also being wet. The most of the current conducted by the hose stream passed through my body to the other side of the circuit; as the resistance of the water in the 50 feet of hose between the nozzle and the hydrant was very great compared with that of the human body.

The shock which I experienced was very slight. I changed the nozzle tip to one and one-quarter inches. The sensation was somewhat increased, but was not unpleasant.

The water used was town drinking water containing 23 milligrammes of mineral matter per litre and the resistance of the hose stream was about two million ohms as calculated from the measured conductivity of the water. Well water in this location has a conductivity about four times the above. In a lime region the surface waters would probably have a conductivity five or six times the above and well waters might have ten or fifteen times. The conductivity of sea water would be about 200 times as great.

It would seem that not much is to be feared from ordinary lengths and sizes of hose streams supplied with drinking water when applied to 2,000-volt wires. With sea water or streams from chemical engines the results would be different and dangerous shocks might result.

F. J. HOXIE, *Electrical Engineer.*

GARBAGE TANKAGE STORED IN FERTILIZER WORKS.

Garbage tankage is a low-grade fertilizing material or filler, obtained as a product of garbage reduction plants located near large cities. Its chief fertilizing constituents are nitrogen, phosphoric acid and potash.

A few words as to its source and manufacture would probably not be amiss. The "garbage" as collected for utilization processes is not a product from street sweepings as is commonly supposed; neither the removal of stable manure or the burning of paper and rubbish have anything to do with it. In its proper acceptation or sense, the term is limited solely to such organic waste as comes from kitchens, market stalls and fruit and fish dealing establishments. Its best definition is "food waste." From data obtainable it is noted that in the winter time garbage consists

largely of fish and animal matter, whereas in the summer time there is added to the constant quantity of the former a large quantity of refuse vegetables and fruit.

The purpose of garbage utilization plants is to produce two substances from the garbage; first, grease which is used for soap stock and candle making, and second, garbage tankage. The usual mechanical processes involved in these plants are about as follows: Garbage is first introduced into steel digesters and subjected to the action of steam for about ten hours or until the mass is cooked to a soft pulp. The pulp is then placed in hydraulic presses and the oily matter and water expressed. The press cake is broken and placed in revolving steam-jacketed dryers. After drying the tankage is pulverized and sifted, in which condition it is ready for the market. There are other processes in vogue in which the oily matter is extracted from garbage by use of inflammable volatiles such as benzine, naphtha, etc., and occasionally a dilute solution of sulphuric acid is added to garbage in the usual mechanical process.

So much for the source and manufacture of garbage tankage; now, as to the hazard in the storage of same in fertilizer factories. Ordinarily there are four factors entering into the cause of the "heating up" of this organic ammoniate. (1) Considerable quantity of oily matter not pressed out or extracted from garbage and left in tankage, or incomplete treatment with sulphuric acid. (2) Excessive moisture content caused from improper drying. It is not thought that after complete drying a sufficient quantity of moisture would be absorbed from the atmosphere by this material to render conditions dangerous, however, the tankage may become wet in transportation or may be stored in a building having a leaky roof, in either case of which the hazard would be increased. (3) Large quantity of material stored with poor ventilation, and (4) Long length of time stored. With these four factors in force the conditions are ripe for quick decomposition which is the oxidation of substance and is always accompanied by heat, the rise in temperature depending upon the rate or speed of chemical action, and unless some retarding action or force is brought to bear, it is believed spontaneous ignition is sure to develop.

Without entering into any technical discussion of the matter, the following are suggestions which if it were possible to have complied with, I believe would safeguard this hazard to a marked degree; however, under present conditions the compliance with No. 2 suggestion appears to be at this time the only practical means of minimizing this hazard and affording some protection to companies against indiscriminate storage.

(1) Oily matter and water should be thoroughly removed from tankage before same is shipped from garbage utilization plants to various fertilizer works, or else the tankage should be thoroughly acidulated with sulphuric acid. In reference to latter statement it is thought that owing to comparative small quantity of acids of phosphorous formed the reducing effect by carbonized matter as regards the hazard would be inappreciable, and at the same time bacteria or germ growth would be killed.

(2) Garbage tankage should not be allowed to be stored in main

fertilizer buildings exceeding one day's supply and only permitted to be stored in buildings well detached and designed with a view toward securing maximum ventilation.

(3) Some limitation should be placed on the quantity of material allowed to be stored in a single pile (twenty-five tons is considered a maximum), and periodical tests should be made at center of pile to determine the temperature; vent holes should be made in piles and channels made running under same so that material can be taken from bottom of piles as needed instead of at top as now removed.

This circular letter is brought to the attention of the companies in view of the fact that I am informed that garbage tankage is being used to quite an extent in fertilizer factories in the South. Inspectors have been instructed in making reports hereafter on fertilizer plants to state whether garbage tankage is used and if stored to advise as to manner of storage.

F. E. MacKNIGHT, *Chief Inspector.*
The South-Eastern Tariff Association.

Atlanta, Ga., December 11, 1907.

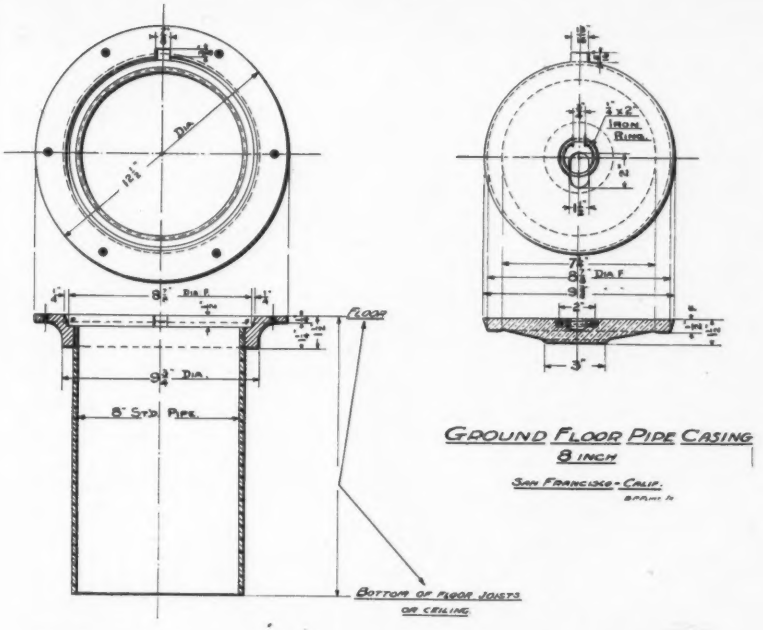
FLOOR HOLES FOR HOSE STREAMS.

ORDINANCE NO. 1112.
(Approved January 27, 1904.)

Providing for the Construction of Ground Floor Pipe Casing Holes in and Through the Floor of the First Story of Any Building Now Erected or Hereafter Erected in the City and County of San Francisco, where the Basement Thereof is Being Used, or is to be Used, for the Storage of Goods or Merchandise, in Order to Enable the Fire Department of Said City and County to Promptly Extinguish Any Fire Occurring in Such Basement.

Be it ordained by the People of the City and County of San Francisco as follows:

SECTION 1. In order to enable the fire department of the City and County of San Francisco to promptly reach and extinguish fires occurring in the basements of buildings in said City and County, and which basements are being used, or are to be used, for the storage of goods or merchandise, without the loss of valuable time in having to cut holes through wood and concrete floors over such basements for the purpose of gaining access thereto, every building already erected and every building hereafter erected in said City and County, where the basement thereof is being used, or is to be used, for the storage of goods or merchandise of any description, shall be provided with ground floor pipe casing holes constructed in and through the floor of the first story of such building, extending down to and even with the basement ceiling, or bottom of floor joists of such first story floor, so as to enable the said fire department to put a water circulating nozzle through for the prompt extinguishment of any fire occurring in any such basement. Such ground floor pipe casing holes shall be constructed according to the plan therefor on file in the office of the Board of Public Works of said City and County



and shall be located and of such number as may be determined upon by said Board of Public Works after a consultation held for the purpose with the Chief Engineer of said fire department or an assistant engineer thereof, such number not to exceed one to every sixteen hundred feet of floor surface or part thereof.

SEC. 2. No goods or merchandise of any description shall be stored in any such basement, in such manner as to interfere with the proper working of the water circulating nozzle used by said fire department which will pass through any of such ground floor pipe casing holes; and no goods, merchandise or any other obstruction shall be placed over the cover of any of such ground floor pipe casing holes, on the floor of the first story; and all such covers must at all times be kept clear of all obstruction, so as not to interfere with their prompt use by said fire department in case of fire.

Note—Portland, Oregon, has a similar Ordinance.

LOS ANGELES BUILDING ORDINANCE No. 12,800 BASEMENT PIPE INLETS.

SEC. 125. The cellar or basement of any store, warehouse or factory shall have through its ceiling a pipe inlet with cover flush with the floor above. Said pipe inlet shall not be less than eight (8) inches in diameter and shall be kept free from any obstruction.

Where the cellar or basement is more than fifty (50) feet wide there

shall be two such inlets in width of room and these shall be repeated for every eighty (80) feet in depth or fraction thereof.

Submitted by F. H. PORTER, *Chief Inspector.*
The Fire Underwriters' Inspection Bureau.

GAS ARC LAMPS.

An investigation of several recent fires in this city has developed the fact that quite a serious hazard exists in mercantile and manufacturing risks wherein gas arc lamps are used for lighting purposes. These gas arc lamps will be found in almost every town and city having a public gas lighting plant, and the lamps in question will be found principally in mercantile establishments.

These lamps consist of a cluster of three, four and five burners, within a glass globe, are fed from one gas supply inlet, the bottom part of the lamp being open. The burners are of a large sized nature with a Welsbach or similar type of incandescent gas mantle. Investigation developes that either due to a superheated condition of the mantle or the age of the same, from time to time while burning these mantles throw off a fine hot carbon or composition substance which drops through the bottom of the lamps and is apt to ignite any combustible material underneath. One manufacturer advises that a carbonized substance will form on these mantles by improper mixture of air and gas, and under a superheated condition will drop off, and naturally fall through base of light.

This hazard has become quite common and we are insisting on there being placed at the bottom of burner or base of light a wire gauze of not less than No. 14 mesh, to catch any hot substances. Wherever these burners may be found, unless so protected, this serious hazard will exist, and your special attention is invited to this feature, in order that some safeguard may be recommended.

We might state that the composition of these mantles and process of manufacture consists of ordinary cotton cloth which is treated with a chemical solution, after which the cotton is entirely consumed under a fire heating process, leaving a chemical sediment, which forms the base of the mantle: this base is then dipped into a solution of colodion which preserves the form of the mantle until used. This is one process, and we assume that all of these mantles are made about in this manner.

A fire recently occurred in the shirt-waist factory of Hexter & Co., Whitney Power Block, this city, and underneath one of these lights was a table containing cloth; the fire started in the cloth from a hot substance from the lamp dropping on it.

A similar fire occurred recently in the clothing factory of Goldsmith, Joseph, Feiss & Co., Swiss Street, this city, and was witnessed.

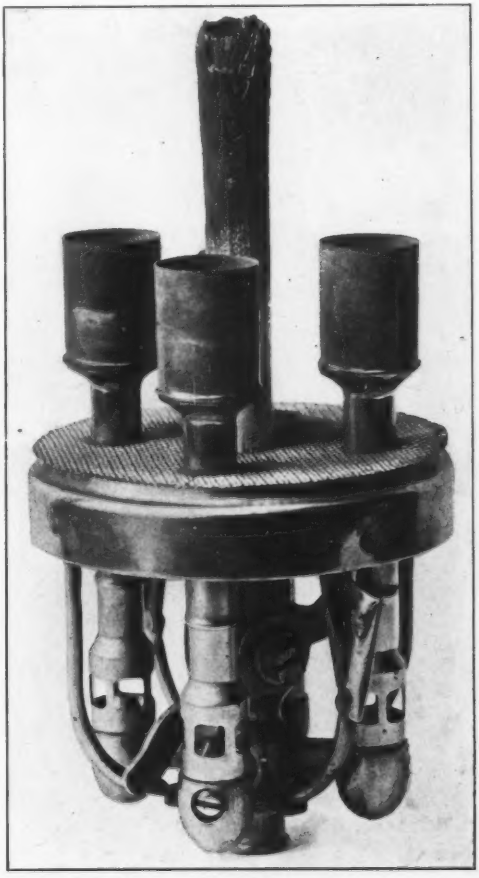
Another supposed case was a recent fire in risk of The Credit Clothing Company, 70-72 Public Square, this city, in which instance a lamp of this character was above a table containing light wearing apparel, the fire starting in or about this material.

On account of this appearing to be such a common hazard seems to warrant us in making special mention of the same to insurance people.

C. H. PATTON, *Publisher,*
The Cleveland Inspection Bureau.

HAZARDS OF GAS ARC LAMPS.

Recent fires reported as being caused by incandescent particles falling from ordinary four mantle gas arc lamps, have brought attention to a common hazard which is often ignored. The ordinary gas



Gas Arc Lamp With Feed Pipe Burned Off.

arc lamp consists of a group of burners having upright mantles surrounding the pipe which supports the burners and carries the gas. These burners are generally enclosed by a globe which is open at the bottom, and any particle of matter falling from the lighted burners will, if it has sufficient heat retaining capacity, be able to ignite flimsy material which may be placed underneath.

In endeavoring experimentally to duplicate actual conditions, it is necessary to take into consideration the many phases in the life of a mantle, and even of the lamp itself. Let us look at a new lamp equipped with new mantles and with burners properly adjusted. Here we have a condition where, if the lamp is undisturbed, there is but little hazard from falling particles. However, jar the lamp enough to break the mantles and a shower of particles will fall through the opening in the globe onto whatever material may be lying below, but by actual test even this has been found to be not enough to cause a fire in the most flimsy material, on account of the small heat retaining capacity of the thorium of which the mantles are composed. It may be said, however, that if the hard twist of rope by which the mantle is suspended from the support, or if the support itself is broken, even wood may be charred if the broken pieces are incandescent when starting to fall. To break either the support or the rope suspending the mantle requires a shock which is sufficient to break the globe of the lamp, and we would therefore consider the hazard from this source as less than others mentioned hereafter.

Another condition which may be found when using new burners and new mantles is the improper adjustment of the burners. Tests have been made with burners so adjusted as to allow the mantles to carbonize, and although it was found more difficult to carbonize the mantles of an arc lamp than a single mantle, it was found that a few hours burning would give a heavy deposit of carbon which, when jarred even slightly, would give off a shower of incandescent particles which retained heat enough, after falling eighteen (18) inches, to char their way through several layers of tissue paper. It was found that the turning on or off of the arc, which was provided with a pilot light, would cause numerous sparks to fall, and I have no doubt that, even if the distance was several feet, these bits of carbon would possess enough heat to start a smolder in a light material.

Age adds hazardous conditions to the mantle, and its support as well as to the burner. Old mantles are easily carbonized and are generally greatly weakened. Their support, if of metal, is oxidized and weakened, and is ready to give off hot particles or even to drop the mantle. No doubt fires have been caused by these latter features, and presumably if tests were extended sufficiently, it would be possible to start fires under observation. It is a fact, however, that fires have undoubtedly occurred from falling particles of oxide from metal parts of the lamp, and we even have record of fires caused by gas arcs burning in two and allowing the lower part of the lamp to fall on inflammable material. This latter occurrence is not a common one, but still it must be guarded against.

If we consider all of the hazardous conditions mentioned above, it will be seen that the hardest to guard against is the falling of the lower portion of the lamp. It is possible, by the proper arrangement of

shields, to prevent falling particles of carbon or oxide doing damage to material lying underneath, but the dropping of the lower part of the lamp can be prevented only with difficulty.

E. J. SMITH, *Engineer, Gases and Oils,*
The Underwriters' Laboratories, Inc.

GASOLENE FIRE ENGINES.

After long series of experiments, the first really practical form of gasolene fire engine for both city and village use has been constructed by the Westinghouse Company of Schenectady, N. Y., and delivered on 30-day trial for regular service in the Schenectady Fire Department. This very important development in apparatus for municipal fire protection has caused considerable interest among the city fire department officials, especially throughout New York State, and the successful termination of the prescribed 30-day test by the Schenectady authorities has proven, beyond a doubt, the great field that there is for the gasolene engine as a reliable substitute for the old "steamer."

The gasolene engine, struggling hard to overcome popular sentiment and prejudice against its uniform reliability under all conditions of service, has many advantages, as compared with the steam engine, for public fire department use, and the designs developed for this particular service show every possible safeguard against failure to operate under the varying conditions peculiar to this class of apparatus.

The engine used is of the four cylinder, vertical type, and is built with the less important features similar in all respects to those of the standard Westinghouse Engine listed by the National Board of Fire Underwriters. It has a positive, single plunger pump feed for gasolene and for lubrication. The cooling of the cylinders is accomplished by means of water taken through a by-pass from the main pump, and an auxiliary standpipe or water column is provided whereby the cylinders may be cooled while the water from the main pump is not in circulation. The engine is equipped with the regular jump spark ignition apparatus, duplicate sets of spark plugs and energizing outfits being provided, and these are controlled by appropriate indicating switches making each combination entirely independent, in this manner guarding against any possible interruption of the engine movement during fire service. In the electrical equipment, either dry batteries or a small dynamo with duplicate storage battery outfits may be used, the current from the generator alternately charging the two sets of batteries supplied; the dynamo is directly connected, by means of friction gears, with the main engine shaft. The gasolene feed cup is somewhat larger in capacity than that of the standard engine, but supplies fuel for all four cylinders; the gasolene supply is carried in a 40-gallon steel tank on the underside of truck, and is, under normal conditions, sufficient for a continuous 12-hour run of the engine.

The pump is of the impeller rotary pattern, having bronze runners, and is directly connected with the engine through flexible coup-

lings. The air chamber is of modern type and of low design, providing a smooth and even discharge. Connections to the pump are especially designed to provide for quick adjustment of couplings in varied positions of the engine at hydrant, pond, or cistern, and for this purpose the 4-inch suction or hydrant connection is arranged to swivel from one side of the engine to the other; this together with the three 2½-inch discharge outlet connections, which are also flexible to allow arrangement in desired directions, are readily locked to prevent all leakage of water or air.

The truck or carriage has flexible springs at both front and rear axles, and has a ball bearing action for the swing of front axle, thus avoiding jar and incident results while driving to fires. All parts of

Gasolene Fire Engine.

the engine and carriage are of substantial design, and the style of mounting produces a steady running of the engine without vibration. The engine control permits a speed variation of from 200 to 600 revolutions per minute, and the capacity of the outfit is guaranteed not less than 600 gallons per minute, which compares favorably with the average third class steam engine of modern design.

The tests, on which approval of this gasolene engine was based, were conducted under the direction of Chief Henry R. Yates, of the Schenectady Fire Department, and while including service on city hydrants, were for the most part carried on with the pump drawing water from a small pond on the outskirts of the city; especially severe conditions of service were imposed upon the engine during the exhaustive tests conducted, and on many days of the month the temperature hovered around the zero mark, with high wind blowing, without

any delay in starting or interruption of engine movement, this justifying claims of the manufacturer regarding ability of the apparatus to operate satisfactorily under all normal temperature variations.

One of the notations recorded on the log of the fire department covering the 30-day test referred to a public exhibition of the engine lasting about three hours, during which water was drawn from the pond, a lift of 10 feet, 6 inches, and at a gage pressure of 150 pounds, a 1½-inch stream covered a distance of 210 feet horizontally and 180 feet vertically, this and other high pressures being readily attained by slight movement of the gasolene regulating valve, and accurately maintained without the troubles incident to maintenance of such pressures in the small boiler of a steam engine. At one time during this same test, while water was being drawn from two of the engine outlets, the piezometer registered a combined discharge of 679 gallons per minute, the engine easily maintaining these conditions without jarring. On another occasion while pumping from the pond, the time required to start the engine was recorded, unknown to the operator, and it was found that a period of only ten seconds was required to start the engine, draw water from the pond and deliver it at the nozzle; where pumping from city hydrants the service pressure is generally sufficient to start the engine in motion, and regulation of the controlling mechanism is all that is necessary to place the apparatus under full running load.

The initial as well as operating costs of this gasolene engine equipment are far less than those of the steam engine, and the weight is approximately 25% less than a "steamer" of equal capacity. These, as well as other valuable points in favor of the gasolene engine, will undoubtedly serve to bring it into prominence in the field of fire fighting apparatus, and give it preference over the more highly polished and distinguished looking "steamer" equipments.

ARTHUR M. PADDON, *Engineer,*
The Underwriters' Laboratories, Inc.

National Fire Protection Association

ADVANCE PUBLICATION OF COMMITTEE REPORTS

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These Reports Will Receive Consideration at the Annual Meeting to be Held at Chicago

May 26, 27, 28, 1908

Report of Committee on
SPECIAL HAZARDS AND FIRE RECORD.

HENRY A. FISKE, Chairman.
P. O. Box 1284, Hartford, Conn.

A. Bauvelt,	M. F. Jones,	W. D. Matthews,
G. W. Cleveland,	C. S. Kremer,	C. H. Phinney,
Gorham Dana,	J. B. Laidlaw,	W. G. Sanderson,
W. D. Grier,	F. E. MacKnight,	T. B. Sellers.

Up to this year the work of this Committee has been along the following lines. First, the preparation of articles or papers on manufacturing processes or hazards. Second, the appointment of sub-committees to investigate and report on special hazards. Third, securing reports on fires and tabulating same. Fourth, publishing the Special Hazard Quarterly Bulletin devoted to the above mentioned matters.

During the last year the Chairman was appointed Editor of the Association's "QUARTERLY," which has taken the place of the Special Hazard Bulletin and is published under the direction of the Executive Committee. The publication work and fire record therefore now comes under the editorial department, leaving only the investigation of special hazards and processes to the Special Hazard Committee, so far as its past work is concerned. The work formerly handled by the Committee on Factory Standards has been turned over to the Special Hazard Committee with the suggestion that this committee prepare articles or reports on the various manufacturing industries along the lines of special construction and protection, the purpose being to present these reports at our meetings for discussion and possible acceptance, thereby allowing us to print and distribute the best information we are able to obtain upon these important subjects. As an example of what may be desired in this line, the Chairman submits a report on Metal Workers which it is hoped will be discussed in a general way so that the Committee may better know how to proceed in the future.

ARTICLES AND PAPERS.

The following articles have been prepared during the year by members of this Committee and other Associate members who have been requested to aid in this work or who have voluntarily contributed.

Shirt, Collar and Cuff Factories and Laundries,
Edward H. Keith.

Denatured Alcohol,
J. Albert Robinson.

The Cement Industry of the United States,
F. E. MacKnight.

The Tobacco Industry,
Ira G. Hoagland.

Automobile Garages, Alfred G. Patton.

Combination Heating and Ventilating Systems, F. M. Griswold.

Stocks and Preparing Machinery of Certain Textile Mills and Their Hazards, Wm. H. Fisher.

Modern Fire-Proof Power Houses, C. B. Mackinney.

A Method for the Classification of the Hazardous Properties of Certain Liquids, A. H. Nuckolls.

Cement Plants, F. M. Griswold.

Plaster Mills, F. M. Griswold.

Metal Workers, H. A. Fiske.

A number of articles have been assigned and may be expected to appear in the "QUARTERLY" later on.

The index of the Special Hazard Bulletins, No. 1 to No. 17, has been prepared and distributed to members. Back copies of the Bulletins may be secured by addressing the Secretary or the Editor and schedule of prices has been published in the "QUARTERLY."

SUB-COMMITTEES.

The Sub-Committee on Celluloid, W. D. Grier, Chairman, will make a separate report completing the work begun last year.

The Sub-Committee on Denatured Alcohol, H. A. Fiske, Chairman, has submitted progress report in the "QUARTERLY" and investigation work is still being continued. This subject is a very broad one and it is difficult to secure the necessary data or make a thorough investigation with the time at our disposal. It is hoped that the Underwriters' Laboratories will take up this question and sooner or later make a thorough and careful investigation and report to our Association at some later date.

So far as this Committee is concerned we cannot perhaps go further at this time than to repeat the conclusions as given on Page 88 of the October "QUARTERLY."

"The low grade kerosene required in the government formula may be ignored in that it is no more hazardous than the wood alcohol which latter constitutes the chief denaturant so far as percentages are concerned. The hazard of denatured alcohol must be classed somewhere between ordinary alcohol and wood alcohol, and flash point tests, while indicating only one phase of the hazard, tend to show that denatured alcohol is nearer ordinary alcohol than the more volatile wood alcohol. The Committee hopes to make additional tests in order to, if possible, more definitely fix the hazard in comparison with the two types of alcohol. If, as it now appears, denatured alcohol is at least somewhat safer to use than wood alcohol it would not seem necessary to advocate more stringent regulations than for the latter. Furthermore when

we consider that denatured alcohol will not only replace wood alcohol in many cases but also may replace more hazardous compounds, such as benzine and gasolene, it appears that its general introduction, under proper restrictions, should tend to reduce the fire loss rather than increase it."

FIRE RECORD.

We have continued to send out fire report blanks and endeavor to secure detailed reports on fires as in the past. This includes chiefly sprinkler fires, fires in manufacturing risks and fire-proof building fires. We have during the past year received over 2,000 reports in all, most of these being made out on the regular printed blank with details. We cannot too strongly emphasize the value to the Association of these reports for when analyzed and tabulated they give us the complete story of fires and their lessons. We again ask the co-operation of all members in this work and we wish to thank those who have in the past given their assistance.

We would call special attention to fires in fire-proof buildings. We have as yet received but few reports on this class and hope that members will bear this in mind and send us any items of interest. We have prepared a special blank for fires in fire-proof buildings and these can be obtained in any number desired either through the Editor or the Chairman of the Committee on Fire-Proof Construction.

Unsatisfactory Sprinkler Fires.

In 47 cases, or about 6%, the sprinklers were unsuccessful in holding the fire in check, and we give below a summary of those fires, together with the probable cause to which the unsatisfactory results are attributed.

December 27, 1906. 5818. Uxbridge, Mass. WORSTED MILL. Sprinkler pipe clogged so that when sprinklers opened water only trickled out of the head.

February 28, 1907. 5246. Cleveland, Ohio. PICTURE FRAME FACTORY. Fire in dry kiln controlled by sprinklers. Sprinklers were shut off. Several hours later a second fire broke out and at that time the system was out of commission.

March 1, 1907. 5812. Marlborough, Conn. SILK WEAVING MILL. Generally defective system. Unapproved Kane sprinklers with deficient water supply.

March 13, 1907. 5831. Bridgeport, Conn. PLANING MILL. Dry kiln fire with high test sprinklers, small pipe sizes and obstruction to distribution from the lumber. Generally defective equipment.

March 15, 1907. 5845. Brighton, Vt. FURNITURE FACTORY. Sprinkler system of little or no value and probably system was frozen.

March 22, 1907. 5856. Randolph, Mass. SHOE FACTORY. Severe exposure fire to frame building. Poor outside protection.

March 22, 1907. 5860. Pine Bluff, Ark. PLANING MILL. Fire started in unsprinklered basement due to hot box on main shaft.

March 25, 1907. 5861. Cincinnati, Ohio. SHEET METAL WORKER. Old style equipment, dry pipe system with obstruction to distribution and light water supply.

March 27, 1907. 5864. Philadelphia, Pa. COTTON SPINNING MILL. Fire controlled by 45 sprinklers. Water was shut off and fire started up again later on with sprinkler system out of service.

March 28, 1907. 5881. Syracuse, N. Y. SASH, DOOR AND BLIND FACTORY. Dry kiln fire with high test defective sprinklers.

April 4, 1907. 5883. Chicago, Ill. FURNITURE FACTORY. Generally defective equipment with small tank the only supply.

April 11, 1907. 5913. Lockhart, S. C. COTTON MILL. Sprinkler system shut off at time of fire through mistake.

April 21, 1907. 5919. Northampton, Mass. SAW MILL. System out of commission owing to the fact that it was being overhauled and brought up to standard.

April 21, 1907. 6054. Massachusetts. COTTON MILL. Sprinkler pipe clogged with gravel so that four sprinklers were of little value.

April 22, 1907. 6056. Port Blakely, Wash. SAW MILL. Water shut off system on account of repairs. Dry pipe valve being relocated.

April 29, 1907. 5934. Union City, Pa. CHAIR FACTORY. Fire started in unsprinklered space underneath addition.

May 11, 1907. 5935. New Hampshire. COTTON MILL. Water shut off sprinklers because system was being overhauled and improved.

May 22, 1907. 5936. Orange, Conn. RENDERING WORKS. Hand plug on dry valve blew off thereby taking water pressure from sprinklers.

July 7, 1907. 6182. Indianapolis, Ind. WHOLESALE DRUG RISK. Adjoining building collapsed causing collapse of risk thereby crippling sprinkler system.

July 12, 1907. M. St. Stephen, N. B. COTTON MILL. Defective town water, hose streams robbed sprinklers of their supply.

July 28, 1907. 6136. Marlboro, N. Y. CARPET YARN MILL. Water shut off sprinklers due to carelessness.

August 8, 1907. M. New Durham, N. J. RUBBER WORKS. Fire occurred in rubber cement mixing room. Large quantity of cement and naphtha. Hazard too severe for sprinklers as installed to control.

August 13, 1907. 6185. Mattapan, Mass. DISMANTLED PLANT. Sprinkler pipe broken during repairs to building. Water shut off.

August 29, 1907. 6080. Rochester, N. Y. CANDY FACTORY. Fire spread to open elevator shaft thereby opening a large number of sprinklers and overtaxing the water supply.

September 2, 1907. 5819. Bay City, Mich. SOFT WOOD-WORKER. Fire in lumber dry kiln. Serious obstruction to distribution from lumber.

September 15, 1907. 6205. Fall River, Mass. COTTON MILL. Fire spread up belt holes opening up a large number of sprinklers and overtaxing the water supply. Some of the sprinklers defective.

September 23, 1907. 6096. Sheboygan, Wis. FURNITURE FACTORY. Severe dip tank fire not controlled by sprinklers.

September 26, 1907. 6215. Chelsea, Mass. CORDAGE WORKS. Tar house fire. Idle plant. Sprinkler system may not have been in service.

October 4, 1907. 6214. Spencer, Mass. WOOLEN MILL. Fire started at dryer. Defective high test sprinklers failed.

November 8, 1907. 6221. Superior, Wis. GRAIN ELEVATOR. Fire started at dock and spread to unsprinklered basement.

November 8, 1907. 6222. Superior, Wis. GRAIN ELEVATOR. Severe exposure fire from neighboring flour mill.

November 8, 1907. 6223. Superior, Wis. FLOUR MILL. Severe exposure fire from neighboring grain elevator.

November 20, 1907. 6219. Pelzer, S. C. COTTON MILL. Cotton storehouse fire partly held in check by sprinklers. Tank was shut off to use pump pressure which later was disabled.

November 28, 1907. 6218. Whitehall, N. Y. SILK MILL. Water shut off sprinklers on account of freezing.

December 2, 1907. 6216. Buffalo, N. Y. CAR SHOP. Railroad car shop high studded building. Sprinklers could not extinguish fire in cars.

December 3, 1907. 6210. New York, N. Y. METAL WORKER. New York and New Haven elbow sprinklers failed to operate.

December 6, 1907. 6217. New York, N. Y. TENANT WOODWORKER. Sprinkler system out of service for some unknown reason.

December 16, 1907. 5895. Waterford, N. Y. FULL PROCESS KNITTING MILL. Water shut off sprinklers for some unknown reason.

December 19, 1907. 6220. Harrisville, R. I. WOOLEN MILL. Fire in dryer, sprinklers clogged with small stones.

December 25, 1907. 6237. Chicago, Ill. TENANT MANUFACTURING. Water shut off before fire was out.

January 2, 1908. 6549. Cateechee, S. C. COTTON WAREHOUSE. Fire in cotton warehouse spread up open elevator hoist and opened up a large number of sprinklers and overtaxed the sprinkler riser.

February 8, 1908. 6239. Wilmington, N. C. SAW MILL. Large frame light constructed saw mill with old style sprinkler equipment.

February 10, 1908. 6879. Lowell, Mass. COTTON MILL. Fire started in hollow roof of attic where sprinklers could not get at it.

February 17, 1908. 6544. Camden, N. J. VARNISH WORKS. Fire started at varnish tank in room used for varnish storage tanks. Owing to the severity of the fire the sprinklers could not extinguish it.

February 20, 1908. 6564. Philadelphia, Pa. COTTON YARN MILL. Fire in spinning room of cotton yarn mill. Walworth pendant sprinklers with good water supply failed to hold fire in check.

February 21, 1908. 6515. Dayton, Ohio. AUTOMOBILE FACTORY. Fire in adjoining building communicated through large unprotected door opening and overtaxed an old style equipment.

February 22, 1908. 6499. Minneapolis, Minn. PAIL FACTORY. Water shut off sprinklers for some unknown reason. Sprinklers in another portion of building operated and saved that end of the risk.

	1908.	1897-1908 Inclusive.
Water shut off for unknown reason, neglect or carelessness	5	27
Water shut off due to freezing	1	17
Water shut off before fire was out	2	14
Water shut off due to repairs	4	10
Water shut off, probably incendiary	0	6
Water shut off, system out of service	0	4
Water shut off, leaky dry system	0	3
Water shut off after first fire	1	3
Water shut off in generator room	0	1
Water shut off due to flood	0	1
Total number shut off	13	86
General defective or obsolete equipment, including unapproved or defective sprinklers	7	57
Hazard of occupancy and construction beyond control of sprinklers as installed (such risks as grain elevators, cooperage, celluloid, oil cloth works, saw mills, fuse works, benzine dip tanks, varnish works, etc	4	38
Exposure	4	29
Fire occurring in unsprinklered section	3	27
Obstructions to distribution	2	21
Water supplies or system crippled by explosion	0	12
Fire gained headway under light water pressure	0	11
System or supplies crippled by freezing	1	9
Concealed spaces	1	7
High test heads failed	1	7
Inoperative or defective dry valve	1	7
Vertical openings	3	7
Insufficient water supply through street or sprinkler connection	0	6
Waterworks supply defective or temporarily out of service	0	4
Sprinklers or pipe clogged	3	4
Large or slow acting dry system	0	3
Lack of watchman	0	2
Fire outside of building or on roof	0	2
Water taken away by hose streams	1	2
Steam pump broke down	1	2
Pump pressure not put on sprinklers	0	1
Hose connection on sprinkler pipe	0	1
Corroded sprinklers	0	1
Defective check valve obstructed pump	0	1

	1908.	1897-1908 Inclusive.
System overtaxed due to large number of sprinklers opened by blower system	0	1
Poor spacing in joisted pitch roof attic	0	1
Car barn with defective water supply	0	1
Defective sprinkler alarm	0	1
Gravity tank temporarily out of service	0	1
Building collapsed	1	1
Not classified	1	6
	47	359

These same fires differently grouped summarize as follows:

	Number	Per cent.
Defective or partial equipment	87	24
Failure due to water being shut off	87	24
Hazard too severe for control	38	11
Faulty building construction and obstruction	35	10
Exposure or conflagration	29	8
Inadequate or light water supply	21	6
Water supplies crippled by explosion	12	3
Defective dry valve or dry system	10	3
Water supplies crippled by freezing	9	2
Unsatisfactory action of high test heads	7	2
Unaccounted for and miscellaneous	24	7
	359	

The classification of the unsatisfactory fires brings out similar lessons to those which have been called to our attention in the past. There were 13 cases of water shut off for various reasons as against 18 for the year previous, making the grand total of unsatisfactory fires due to water shut off 87. This is approximately one-fourth of the unsatisfactory fires. There were four cases of water shut off due to repairs, emphasizing the danger due to sprinkler system being even temporarily out of service. It is of course necessary to shut off sprinklers at times but generally the system can be kept in service over night or the length of time materially reduced by extra haste in completing the work. The general idea might be that comparatively little chance was taken with the system out of service for only a few days, but experience has shown that fires do occur at just such times and the results are disastrous.

In two cases the water was shut off before fire was completely extinguished, that is, it started up again with the system out of service. This shows the need of positively determining conditions and putting the sprinkler system in service again at once. Sprinklers should always be kept on hand for just such emergencies. There was one important fire where the water was shut off due to freezing which shows the need of properly heating such places or putting the sprinklers on a dry system.

There were the usual number of severe fires in risks with old style equipments, defective sprinklers, etc.

We also find four fires where the hazard of occupancy was beyond the control of the sprinklers as installed, showing that such classes of risk cannot be positively protected by sprinklers or else they need especial treatment. These fires occurred in a saw mill of ordinary poor construction, a varnish works with the fire starting at varnish storage tanks, a rubber cement mixing room and a benzine dip tank.

There were the usual cases of exposure, unsprinklered portions, obstruction to distribution, vertical openings, etc. In three cases it was reported that the sprinkler pipe was clogged, which circumstance more clearly emphasizes the possible importance of this feature.

SUMMARY OF FIRES.

We give a summary of fires in the following eight tables. Number of fires reported, 751, not including 147 fires where no sprinklers opened. Total for 1897 to 1908 inclusive, 6356, being a twelve years' record.

Table No. 1.

Time of day.	Times Reported. 1908.	Times Reported. 1897-1908 Inc.	Per Cent. of No. with Data Given. 1908.	Per Cent. of No. with Data Given. 1897-1908 Inc.
6 a. m. to 6 p. m.	475	3509	64	59
6 p. m. to 6 a. m.	263	2414	36	41
No data	13	303		

Table No. 2.

How discovered.	Times Reported. 1908.	Times Reported. 1897-1908 Inc.	Per Cent. of No. with Data Given. 1908.	Per Cent. of No. with Data Given. 1897-1908 Inc.
Employee	462	3559	63.11	57.32
Watchman	109	930	14.89	14.98
Sprinkler Alarm	98	1051	12.02	16.94
Outsider	41	369	5.60	5.94
Thermostat	21	296	2.87	4.76
Automatic Pump	1	4	.13	.06

Table No. 3.

Failure of Alarm Service, 1908.

	Satisfactory. No. of Fires.	Satisfactory. Per Cent.	Failure. No. of Fires.	Failure. Per Cent.	Total.
Watchman alone	57	95	3	5	60
Sprinkler alarm alone	66	94	4	6	70
Thermostat alone	6	80	2	20	8

	Watchman.		Sprinkler Alarm.		Thermostat.		Total.
	Satisfactory.	Failure.	Satisfactory.	Failure.	Satisfactory.	Failure.	
Watchman and Sprinkler Alarm	46	29*	65	10	—	—	75
Watchman and Thermostats	—	—	—	—	—	—	—
Sprinkler Alarm and Thermostats	—	—	27	1	20	8	28
Watchman, Sprinkler Alarm and Thermostats,	2	5*	7	0	3	4	7

*These include fires where sprinkler alarm or thermostats notified the watchman.

Note.—These tables do not include fires where alarm service does or does not operate properly if fire is at once discovered by employee, the alarm service having no bearing on such fires one way or the other.

Table No. 4.

Number of Sprinklers Operating.	Number of Fires. 1908.	Number of Fires. 1897-1908 Inclusive.	Per Cent. of Whole. 1908.	Per Cent. of Whole. 1897-1908 Inclusive.
1	213	1838	28.36	30.32
2	106	901	14.11	14.86
3	70	553	9.32	9.11
4	69	399	9.19	6.59
5	41	293	5.45	4.84
6	30	241	3.99	3.98
7	20	157	2.66	2.59
8	13	156	1.73	2.57
9	8	105	1.07	1.73
10	12	91	1.60	1.50
11	7	78	.93	1.29
12	4	100	.53	1.65
13	9	57	1.20	.94
14	9	73	1.20	1.20
15	9	55	1.20	.91
16 to 20	27	184	3.60	3.04
21 to 25	12	106	1.60	1.75
26 to 30	13	83	1.73	1.37
31 to 35	4	44	.53	.73
36 to 40	6	42	.80	.69
41 to 50	11	70	1.46	1.16
51 to 75	17	112	2.26	1.85
76 to 100	8	48	1.07	.79
Over 100 (including large number or all)	33	276	4.39	4.55

Table No. 5.

Number of Sprinklers Operating.	Number of Fires. 1897-1908 Inc.	Per Cent. of Whole. 1897-1908 Inc.
1	1838	30.32
2 or less	2739	45.18
3 or less	3292	54.31
4 or less	3691	60.89
5 or less	3984	65.72
6 or less	4225	69.67
7 or less	4382	72.29
8 or less	4538	74.86
9 or less	4643	76.59
10 or less	4734	78.09
11 or less	4812	79.38
12 or less	4912	81.02
13 or less	4969	81.98
14 or less	5042	83.17
15 or less	5097	84.08
20 or less	5281	87.12
25 or less	5387	88.83
30 or less	5470	90.23
35 or less	5514	90.96
40 or less	5556	91.65
50 or less	5626	92.81
75 or less	5738	94.65
100 or less	5786	95.45
Over 100 (including large number or all)	276	4.55

Table No. 6.

Sprinklers Opened on Wet or Dry Systems.	Times Reported. 1908.	1897-1908 Inc.	Per Cent. of No. with Data Given. 1908.	1897-1908 Inc.
Wet	601	3635	83	74
Dry	124	1272	17	26
No Data	26	189		

Table No. 7.

Primary Water Supplies to Sprinklers Opened.	Times Reported. 1908.	1897-1908 Inc.	Per Cent. of No. with Data Given. 1908.	1897-1908 Inc.
Water Works	322	2636	44.39	45.31
Gravity Tank	263	1955	36.18	33.72
Pressure Tank	98	832	13.48	14.35
Automatic Pump	44	344	6.08	5.93
Private Reservoir (see note)		28		.48
Auto. Electric Pump		1		.02
Steamer Connection		1		.02
No Data	17	297		

Note.—Small reservoirs are generally classed as gravity tanks, large reservoirs as water works.

Table No. 8.

Effect of Sprinklers.	Times Reported.		Per Cent. of No. with Data Given.	
	1908.	1897-1908 Inc.	1908.	1897-1908 Inc.
Practically or entirely extinguished fire	476	4039	67.53	71.03
Held fire in check	228	1647	32.37	28.96
Total successful ...	704	5686	93.74	93.77
Unsatisfactory	47	378	6.26	6.23
	751	6064		

Report of Committee on
AUTOMOBILE GARAGES.

ALFRED STONE, Chairman.
49 Westminster Street, Providence, R. I.

R. W. Hilliard, J. V. Nutter, A. P. Stradling,
G. F. H. Howarth, C. H. Patton, Hugh T. Wreaks.
Stewart McDonald, A. M. Schoen,

Section 1. A "Garage" is

a. A building or that portion of a building in which vehicles using or carrying volatile inflammable liquid for fuel or power are kept, whether said vehicles are kept for use, for sale, for rental, for exhibition, or for demonstrating purposes, and

b. All that portion of a building that is on or below the floor or floors on which an automobile carrying volatile inflammable liquid is kept, and is not separated therefrom by approved and unpierced fire walls and floors.

Section 2. A "volatile inflammable liquid" is any liquid that will emit an inflammable vapor at a temperature below 100 degrees F., when tested by a closed test.

Section 3. An "Automobile" is any self-propelling vehicle.

Section 4. All approved devices or "Standards" are understood to mean approved as of N. F. P. A. standard.

Section 5. An automobile carrying a volatile inflammable liquid not to be placed in a building unless all sewer connections from washstands and sinks are provided with an approved oil trap with a glass gage pipe and a draw-off cock, in a readily accessible place and where not liable to injury.

Section 6. Standard building to be of standard fire-proof construction, meaning thereby the building, including floors, interior finish and all exterior attachments. And two stories in height shall be considered standard, with basement allowed only when constructed and used as per Section 17, and with not more than 5,000 square feet area on any one floor, and at least two exits on the ground floor, each at least ten feet wide. Also the level of this floor to be higher than the surrounding streets at all entrances with floors and runways arranged to drain to street entrances. Access to second floor to be only by elevator or incline or stairway with direct entrance to street, absolutely cut off by fire-proof wall from first floor.

Section 7. Standard of repairing and testing room. Repairing and testing to be done in a separate building, except that they will be permitted in a fire-proof room in garage proper, when same is cut off by standard fire walls from the rest of the building, with communication, if any, only through vestibule ventilated to outer air and equipped with a pair of self-closing fire doors, provided with sills raised at least six inches above floor level.

Section 8. Standard of Filling. All filling to be done, if possible, on the outside of the garage, in the open or in a fire-proof building entirely separated from the garage proper.

If, however, filling is done inside of building, it is to be done with approved portable tanks not exceeding 50 gallon capacity each, mounted on wheels and provided with a rubber hose attachment, not to exceed eight feet in length, and equipped at the end with shut off valve with ground key. These tanks to be filled on outside of building or in pump room as hereinafter provided, and when not in use shall be kept outside of building or in pump room or similar room provided for storage of these tanks. Two of these tanks to be a standard filling equipment.

Section 9. Standard Storage. Storage of oils, calcium carbide, grease, and not more than seven tanks of acetylene gas under pressure to be in a fire-proof room entirely cut off from balance of building and properly ventilated to the open air. An opening from this room into building will be permitted if equipped with standard automatic fire doors.

Section 10. Storage tanks shall

1. Not to be installed until application with plans and specifications showing full details of location and construction and all connections have been approved by underwriters having jurisdiction;

a. To be cylindrical;

b. Shall not be placed less than ten feet from a building, except according to 9a and 9b, same section;

c. If placed inside any building that is more than one story high or that has a cellar or basement, to be buried from two to five feet, as may be necessary for safety, below the lowest floor in the building and completely embedded in concrete.

2. Not to have a capacity in excess of 285 gallons;

3. Be made of iron or steel at least three-eighths of an inch in thickness;

4. Be coated on the outside with tar or other rust-resisting material;

5. To have all joints riveted and tightly caulked;

6. Be tested by hydro-static pressure, 100 pounds to the square inch, and all piping to and from tanks shall be installed to stand 25 pounds per square inch.

7. Have all pipe connections at the top;

8. Be buried entirely so that no part of the tank is less than two feet under the surface of the ground, and, in addition:—

a. Tanks that are to be filled by a pipe from the street shall be buried, at least two feet lower than the grade of the street, and—

b. Tanks in the ground that are within 10 feet of any building shall, if practical, be buried two feet lower than the level of the lowest floor in any such building;

9. If impractical to bury as specified in Clause 8b, tank may be embedded in 12 inches of Portland Cement concrete, well tamped in place and—

a. Should there be more than one tank, they shall be separated by at least 12 inches of such concrete, and—

b. Should an underground tank be within 10 feet of the building and not be buried at least two feet lower than the level of the lowest cellar floor of such building, it shall be embedded and surrounded by Portland Cement concrete 12 inches in thickness;

10. Be provided with a filling pipe, a vent pipe, and (if not more than 30 feet from all buildings), a drawing-off pipe;

11. Be provided with an approved pump for drawing off the contents;

12. Be placed so that top of tank will be below the drawing-off point.

Section 11. The vent pipe to be—

1. Made of one and one-quarter (1¼) inch or larger wrought iron or brass pipe with—

a. Heavy iron fittings;

b. Screw joints made of litharge and glycerine or other approved substance not affected by gasolene.

2. Connected with top of storage tank;

3. Carried up to the outer air, be well braced in position, and—

a. Either capped with a double gooseneck with openings.

(1) At least four feet higher than roof of garage;

(2) More than 20 feet from all windows and four feet above roof of higher adjacent buildings, and—

(3) Covered with thirty-mesh brass wire screen;

b. Or closed by a shut-off cock—

(1) If practical, directly over storage tank and otherwise connected to tank by pipe laid with pitch of not less than three inches to 10 feet;

(2) More than 30 feet from all buildings;

(3) Covered by a screen of thirty-mesh brass wire;

(4) Closed by a screw cap when not in use, and—

(5) Enclosed in a metal box, with a cover that is flush with the surface of the ground and is kept locked when not in use;

(6) And so arranged that the filling pipe cannot be opened without opening the vent.

Section 12. The filling pipe to be—

1. Made of two-inch or larger wrought iron or brass pipe with—

a. Heavy pipe fitting, and—

b. Screw joints made of litharge and glycerine or other approved substance not affected by gasolene;

2. Provided with a screen of thirty-mesh brass wire just below the filling cock or valve;

3. Closed at the intake by filling cock or valve, the opening of which shall be closed by a screw cap when not in use. The cap to be securely fastened by a chain;

4. Connected with top (or with valve connected therewith) and extend down to nearly the bottom of the storage tank and below suction pipe.

5. Laid at a uniform grade so that it will drain empty into the tank;

6. Carried up and terminate with the intake and filling cock or valve in—

a. The pump house, or—

b. A metal box, with a cover that is flush with the surface of the ground, is kept locked when not in use, and is more than 30 feet from all buildings; or—

7. Carried up outside of the building and terminate in a covered

box of heavy iron sunken at the curb flush with the sidewalk, kept locked when not in use, and in this case, the shut-off valve shall be provided with a coupling for attaching the hose of a barrel wagon, and shall only be used for receiving volatile inflammable liquid from barrel wagon.

Section 13. Pumps to be of standard approved design.

Standard Pump Room. At one end of the building there may be, cut off from the garage, a room to be known as the pump room, in which should be located the pump controlling the gasolene supply and other apparatus and devices used in connection therewith. This room to be ventilated to the open air at the top and bottom and to have but one opening into the building, which should be closed by a pair of standard self-closing approved fire doors.

Section 14. The pump house to have—

1. No greater capacity than required for—

a. Handling volatile inflammable liquid, and—

b. Storing the safety cans.

2. A cement floor at least six inches lower than the door sill, and not more than 12 inches below the grade of the ground where located;

3. Heavy galvanized iron drip pans—

a. One to cover entire floor of pump house;

b. One to be kept under nozzle of pump.

Section 15. To have an approved brick ventilating flue—

1. Built in the wall opposite the door;

2. Lined with three-inch galvanized iron or tile pipe, eight by eight inches inside measure.

3. Extending from the floor up to and through roof of the pump house to at least four feet higher than the roof of the garage;

4. Capped with an eight-inch, or larger, galvanized iron double gooseneck, with openings remote at least ten feet from windows of higher adjacent buildings;

5. And having an opening—

a. At the floor, six by eight inches;

b. At the ceiling, at least four by six inches,

c. At each end of the double gooseneck the full size of the pipe, and—

6. With all openings protected by wire brass screens, not coarser on one side than 16, and the other side than 30 mesh, soldered to rim of gooseneck or fastened to pipe.

Section 16. Or a ventilating pipe—

1. Made of galvanized iron not less than 18 gage;

2. Not less than eight inches in diameter;

3. Extend from three inches above the floor up to and through the roof of pump house to four feet higher than roof of garage;

4. Be capped by an eight-inch, or larger, 18 gage, galvanized iron double gooseneck with openings remote at least 10 feet from windows of higher adjacent buildings.

5. Have an opening—

a. Three inches from the floor, protected by heavy iron grating and of the full size of the pipe.

b. At the ceiling, at least four by six inches;

c. At each end of the double gooseneck, the full size of the pipe.

Section. 17. Standard for light, heat and power plant, generating plant and switchboards, including electric charging switchboards. These, if any, to be located in basement. The basement to be no larger than necessary to contain all required apparatus and to be entirely cut off from the rest of the building and with separate entrance to the outside and not to be used for either storage or filling or repairing of automobiles. Standard heating to be by steam or hot water and standard lighting to be electricity.

Section 18. Ventilation. Where natural ventilation in a garage appears inadequate, a system of ventilation with openings into the outer air, near the floor, should be installed.

No stove, forge, torch boiler or other furnace, flame fire or fire heat to be allowed, except in the repair room of a garage;

a. All electric motors not actually a part of an automobile shall be located at least four feet above the floor;

b. All electric switches and plugs shall be permanently located outside the building or in fire-proof cabinets at least four feet above the floor.

Section 19. No garage shall contain—

a. Any volatile inflammable liquid in approved safety cans, but two approved 50 gallon portable tanks containing gasolene will be permitted in the building while used for filling automobiles;

b. More than 1,375 gallons (25 bbls.) of volatile inflammable liquid in underground storage tanks;

c. Or 100 pounds of calcium carbide in air tight containers. If in tanks, these should be of ample gauge, with well riveted seams and tested to stand 250 pounds pressure. If in packages, these should not be over two pounds apiece, should be air tight and kept at least six inches above the floor in water tight containers provided with a securely fastened cover.

Section 20. A dead line 10 feet from each entrance shall be established in the garage, beyond which all fires or lights on automobiles or under the boilers thereof shall be extinguished immediately.

Section 21. Smoking to be absolutely prohibited in any room or place in which a volatile inflammable liquid is kept, or in any room or hall opening into such room or place. A notice in large letters —"NO SMOKING"—shall be displayed in a conspicuous place and manner on all floors and at all entrances to the garage, and in all rooms and halls opening into rooms or places in which a volatile inflammable liquid is kept.

Section 22. No volatile inflammable liquid shall be—

1. Used in a garage for cleaning or for any other purpose whatsoever other than filling the tanks of automobiles, except that kerosene in small quantities may be used for cleaning.

2. Allowed to run upon the floor or to fall or pass into the drainage system of the garage;

3. Put into or removed from the tank of an automobile while any light or fire on the same is burning;

4. Carried or kept in open vessels;

5. All volatile inflammable liquids and oils recovered from the oil traps, or by swabbing or sponging up spilled liquid, shall be placed in approved safety can of not over five gallon capacity. And all quan-

tities in excess of five gallons shall be returned to the underground storage tank or removed from the premises forthwith. Also, rubber cement to be handled in two gallon approved safety can.

Section 23. Sand shall be kept—

1. In approved boxes provided with hand scoops, or fire buckets, for fire extinguishing purposes only;
2. In convenient receptacles for use in absorbing waste oil on floors;
3. In bed or metal drip pans under each automobile kept on floors that are not fire-proof.

Section 24. Self-closing metal cans set firmly on four-inch legs shall be kept on floors for the purpose of holding all inflammable waste material.

Section 25. For each 2,000 square feet of floor area, or fraction thereof, there should be kept filled and ready for use one three gallon carbonic acid gas fire extinguisher of approved construction and each floor shall be figured separately in reckoning this equipment.

Section 26. Nothing in these requirements is intended to conflict with any present National Fire Protection Association standards.

a. All approved devices are understood to mean as of N. F. P. A. standard.

Section 27. To provide as far as possible against fire hazard, it is recommended to inspectors having jurisdiction that they endeavor to secure conformity to the directions contained in the following recommendations for sub-standard garages.

RECOMMENDATIONS FOR SUB-STANDARD GARAGES.

Section 27A.

An automobile carrying a volatile inflammable liquid should not be placed in a building—

1. If built of wood and more than 15 feet high or having a capacity for more than four vehicles, or located less than 20 feet from any other building.

Section 27B.

Closets for storing volatile inflammable liquid in safety cans shall, where possible, be outside the main building, and should—

1. Not be larger than required for the purpose;
2. Be lined inside and covered outside with sheet tin, applied with lock joints and blind nailed;
3. Be ventilated to the outer air, and—
4. Be in an unexposed location.

Pumps.

1. If within 30 feet of any building, be located in a fire-proof pump house;
2. Have a shut-off valve with a ground key in the nozzle;
3. Have a check valve between pump and nozzle;
4. Have screw stuffing box for pump rod;
5. Have stuffing box for pump rod higher than outlet of pump.

Section 27D.

No pump or pump house, unless built as hereafter specified, shall be placed in—

1. Building more than one story high;
2. In a building that has a cellar or basement;
3. In the cellar or basement of any building;
4. In an area between a building and a sidewalk;
5. Under a sidewalk, or—
6. Within the stoop line.

Section 27E.

The pump house shall have—

1. No greater capacity than required for—
a. Handling the volatile inflammable liquid, and—
b. Storing the safety cans.
2. A cement floor at least six inches lower than the door sill and not more than 12 inches below the grade of the ground where located;
3. Heavy galvanized iron drip pans—
a. One to cover entire floor of pump room,
b. One to be kept under nozzle of pump;
4. Must be of fire-proof construction, if within 30 feet of a building, and have either—
a. An approved ventilating flue,
b. An approved galvanized iron pipe;

See Standard Specifications.

No openings through the walls or roof, except when protected by two sets of self-closing standard fire doors with lock joints and with space of one foot between same.

Section 27F.

Filling stations shall be located at least 25 feet distant from the entrance to the garage, shall have a tight, unpierced cement or other approved fire-proof floor, graded to a center, and unconnected with sewer or drainage system of the building. The floor shall be kept free from volatile inflammable liquid by sponging or swabbing. The roof shall be kept free from volatile inflammable vapors either by natural or forced ventilation.

Section 27G.

Under no conditions ought gasolene to be carried about in open vessels. Unless standard equipment is possible, five gallon safety cans should be used.

Section 27H.

While it is realized that, in a big garage in large cities, a system of filling automobiles by means of stationary pumps and piping extending round in room and with plugs to put in automobile tank openings and vents to carry off all fumes, so that the filling can be done expeditiously, without exposure of the gasolene to the air in the room, would have many advantages, yet, the inability, as yet, to make a system of exposed piping for carrying gasolene safe, makes in unwise to recommend this method at the present time.

Section 27I.

The adoption of a standard inlet hole in all gasolene tanks is urged so that conical plugs can be used in connection with the hose on portable filling tanks.

The plug to be provided with a vent pipe so that, in process of filling, the fumes of gasolene will not be forced into the garage to any appreciable extent.

Report of Committee on
FIRE-PROOF CONSTRUCTION.

E. T. CAIRNS, Chairman,
76 William Street, New York, N. Y.

F. M. Blake, J. M. Hughes, F. J. T. Stewart,
J. E. Curtis, Clarence F. Low, Alfred Stone,
I. G. Hoagland, A. G. Patton, Henry V. Thayer,
W. P. Walsh.

Your Committee understands that the duty originally assigned to it was the preparation of a Standard for construction of buildings of the so-called fire-proof type, and at last year's meeting of the Association such a Standard was submitted but was not acted upon, for the reason that there were certain differences between this standard and the Building Code of the National Board of Fire Underwriters.

Attempts have been made during the past year to reconcile these differences, with the idea of producing a Standard which would be generally acceptable to all insurance and other interests. Such an undertaking, however, is not an easy task, and we are unable at this time to report any definite progress. A Standard for building construction, particularly of any sort of fire-proof type, is an important matter to many business interests, and it would seem that the best result could only be obtained by these various interests working together for the production of such a Standard.

The question of a general conference for this purpose has been under discussion during the past year and we believe there is good prospect for the appointment of a Conference Committee consisting of representatives of various national associations of architects, engineers, builders and fire protection engineers, and we would recommend that this Association indorse the plan and appoint a Committee for the work.

If the preparation of a Standard is undertaken on this basis, it would probably be found desirable to make it more extensive than the field of fire-proof construction, and very likely to cover the entire scope of ordinary City Building Ordinances. If that is the case, your Committee should be chosen with this in mind. Such an undertaking will, of course, require considerable time, and some patience would have to be exercised in awaiting the results. We believe, however, that it is the only proper basis on which to undertake so important a work.

During the past year, a number of serious fires have occurred in so-called fire-proof buildings, and we should like to include in this report such records of these incidents as we may be able to obtain. At this writing, however, we have not been able to secure all of the data for these reports, and should like the privilege of presenting it at the annual meeting without advance publication.

Report of Committee on
CONCRETE AND REINFORCED CONCRETE
for Building Construction.

E. T. CAIRNS, Chairman,
76 William Street, New York, N. Y.

F. M. Blake,
F. E. Cabot,
F. W. Eames,
John Eynon,
W. I. Fisher,
Convers Goddard,
G. F. H. Howarth,
C. T. Ingalls,
F. E. MacKnight,
A. G. Patton,
F. H. Porter,
W. G. Sanderson,
E. V. Starkweather,
F. J. T. Stewart.

In regard to a Standard for concrete or reinforced concrete construction, this Committee is in the same position as the Committee on Fire-proof Construction, and begs to submit the same recommendation in regard to a Conference Committee with other associations.

We also have in course of preparation some data on fires which have occurred during the past year in buildings of concrete construction, which data is not, at this writing, in shape for advance publication. We should like the privilege of submitting it as a part of this report at the annual meeting.

Report of Committee on
HOSE.

H. W. FORSTER, Chairman,
137 South Fifth Street, Philadelphia, Pa.

A. Blauvelt, L. H. Kunhardt, M. D. Pierce,
G. E. Bruen, F. E. MacKnight, Fitzhugh Taylor,
C. A. Hexamer, R. H. Newbern, E. R. Townsend.

The Committee has given its undivided attention during the past year to the subject of hose for fire department use, and specifications for both cotton rubber lined and rubber hose are herewith submitted. These cover single jacketed hose in the 2½-inch size, and 2½-inch, 3-inch and 3½-inch sizes in double and triple jacketed hose or its equivalent in interwoven fabrics. Single jacketed hose of a heavier type than the 2⅝-inch underwriters' hose is used to some extent in outlying districts in larger cities and more extensively in the smaller ones.

We were interested in finding out approximately how much 2½-inch fire department hose is in use in the United States, and about what amount is annually purchased. The percentage of hose of sizes larger than 2½-inch (or 2¾-inch which is generally used on the Pacific Coast) is comparatively small. We obtained first hand information from 44 of the larger cities and took data covering 14 additional ones from the records of the National Board of Fire Underwriters. The 2½-inch hose used is as follows:

Population of 58 cities	16,691,000
Fire hose in use	2,452,000 feet.
Hose purchased annually	381,000 feet.
Average annual replacement	15.5 %

The number of persons per foot of fire hose in these cities varies from 2 to 17. The average is six and eight tenths (6.8). While this data is of no particular value, it is of interest. Obviously, the larger a city, particularly if the population is dense, the less the hose supply per capita. In the cities in the 100,000 population class, the average is about four persons per foot of hose. In the smaller cities and towns, the per capita supply is undoubtedly higher on the average and the percentage annual replacements smaller. It is therefore difficult to estimate the total amount of hose in use and purchased annually. Assuming however that there are 35,000,000 people living under paid or volunteer fire department protection, and that the hose supply is at the above average per capita the total amount in use would be something over 5,000,000 feet and the amount annually purchased about 800,000 feet. Certain of the hose manufacturers estimate the annual sales of hose suitable for fire department use to be in the vicinity of 2,000,000 feet. Much of this goes to corporations and the Government, but from their estimates the annual consumption by the fire

departments of the country is probably close to 1,500,000. The average selling price of this hose is probably between 80 and 90 cents, and these figures, while not accurate, give some idea of the size of the industry.

Cotton rubber lined hose is used in practically all of the cities of which we have record. New York is the only city of size in which rubber hose is used extensively. For heavy municipal work rubber hose has the advantage of not requiring complete drying after each wetting. Consequently, it is not necessary to have two complete changes for each company. Rubber hose on the other hand costs appreciably more than cotton rubber lined hose of equal quality.

At the outset we got into touch, through visits and correspondence, with the fire department officials of some 40 of the larger cities and obtained from them information as to the manner in which they purchase hose. We found that specifications of some sort, other than the customary time and pressure guarantee, were being used in fifteen of the larger cities. In addition to these, the Navy uses specifications for fire hose. Some of the specifications are comprehensive, others cover only a single point, as for example the limit of elongation. Practically every city has a time and pressure guarantee clause in its hose contracts, although there are a few instances in which pressures only are specified and nothing is said as to the life of hose.

From this it appears that there is a decided need of specifications, national in their scope. Generally speaking, fire department officials are not capable of drafting good requirements for a substance as complex as hose, and among the existing specifications there are quite a number which are drawn in a manner which admits only one brand of hose. In such cases it would be just as well to specify the desired brand. A considerable number of city officials have shown a decided interest in the subject of national specifications and assurances of cooperation have been received from several.

Where specifications exist, they appear to be, on the whole, carefully enforced, but under ordinary conditions where pressure and time requirements are incorporated in the contract, there seem to be but few cities where the new hose is actually tested to the pressure specified, which ranges from 300 to 500 pounds per square inch.

There seems to be great laxness on the parts of the cities in enforcing guarantees. Certain manufacturers have stated that only because this is true is it possible to sell hose at as low a price as they do. The reasons for lax enforcement probably lie partly in the fact that the personnel of the fire fighting and the supply departments changes rather frequently in some cities, that, as a result, matters of records are not always known to the men in charge, and in that marking of dates of manufacture on hose is not always permanent. Occasionally records are not properly kept.

The remedy for conditions as they exist at present, is to have proper specifications, and then to see that the manufacturers live up to these through the medium of factory inspections by the Underwriters' Laboratories, Inc., and to guarantee conformance to the specifications by means of a label, similar to the ones now used on "Underwriters'" hose.

In addition to examining existing specifications, we conferred freely with a number of the leading manufacturers of hose and in several instances had them make a series of tests covering matters of importance.

From the data in hand we prepared a preliminary draft for specifications covering both types of hose and sent about ninety (90) copies of each to fire department officials, hose manufacturers and others interested, with a request for frank criticisms. We received a considerable number of replies. The city officials usually declared themselves well satisfied with the drafts, while the manufacturers generally offered specific suggestions covering various points. All these have been carefully considered and a number of changes made in the preliminary drafts.

In presenting these specifications to the Association, we desire to call attention to the following points:

Cotton Fabrics. We have drawn these sections in as broad a manner as possible, the idea being to make the strength, elongation and twist requirements the important portions, and to permit the manufacturer the maximum leeway as to details and construction.

Rubber Linings and Cover. It is generally admitted that the principal reason for hose failure lies in defective linings and covers, and we therefore have covered these sections in detail.

The chemical and physical test requirements set forth are the same as for "Underwriters'" hose, and are the result of a long and thorough investigation on the part of the Laboratories and the manufacturers' chemists. We cannot do better than adopt these as it will give the manufacturer of the two kinds of hose only one set of requirements to meet.

SPECIFICATIONS FOR THE CONSTRUCTION OF COTTON RUBBER LINED HOSE FOR FIRE DEPARTMENT USE.

1. Size.

a. These specifications cover 2½-inch single jacketed hose and 2½-inch, 3-inch and 3½-inch hose having two or more jackets or plies, separate or interwoven.

b. When intermediate sizes are required, the following rules shall apply, provided, however, that fabrics, finished hose and couplings shall have intermediate weights in proportion to their sizes.

2. Marking.

The name of the manufacturer and the month and year of manufacture to be stencilled upon every piece of hose, twice in each 50-foot length, with BLACK INDELIBLE LETTERS, ONE INCH IN HEIGHT, these marks to be near the couplings.

3. Cotton Fabric.

a. To be plain woven, twilled or knitted, and of one or more jackets or plies, separate or interwoven as specified in 1-a.

b. To be even and firm in texture throughout and free from all injurious or unsightly defects, or defects of any kind except such trifling ones as are incident to the best practical manufacturing.

c. In single jacketed hose the warp shall thoroughly cover the filler.

d. The yarn from which fabric is woven shall not be coarser than number eight (8) and is to be spun and twisted in best manner from selected long staple cotton. Its minimum strength when sixty (60) yards (40 turns of 1½-yard reel) are tested on a Brown Bros.' tester, shall be at least 12½% above Draper Standard for average strength.

For instance, No. 12 yarn shall have a strength of not less than eighty (80) pounds.

e. To have not less than six picks of filling and not less than 13 warp strands per square inch in each jacket or ply, except that in knitted fabrics there shall be not less than seven warps per inch.

f. The weight of 50 feet of fabric to be within the following limits:

Single jacket:

2½-inch not more than 35 pounds.

Two jackets or plies, separate or interwoven:

2½-inch not more than 45 pounds.
3 -inch not more than 55 pounds.
3½-inch not more than 65 pounds.

Three jackets or plies, separate or interwoven:

2½-inch not more than 60 pounds.
3 -inch not more than 75 pounds.
3½-inch not more than 85 pounds.

4. Rubber Lining.

a. Shall contain not less than 40% of pure rubber and be free from any kind of rubber substitute, old vulcanized or reclaimed rubber, or any other injurious adulterants. It shall be of uniform thickness and quality and free from defects throughout its entire length.

b. To be well and properly cemented to the cotton fabric with cement of the best quality, to secure adhesion, durability and at the same time such freedom from corrugations as it is possible to obtain with the best methods of manufacture.

c. Tubes if lap-jointed to have the lap as small and neat as is consistent with the best results.

d. The tubes to be made up of not less than three (3) calendered sheets, the intention being to remedy in three plies, the defects that may occur in one or two.

e. Thickness of tubes exclusive of cement or backing, to be within the following limits:

2½-inch and 3-inch hose not less than No. 17 Stubbs' wire gage (.058″) nor greater than No. 15 Stubbs' wire gage (.072″).

3½-inch hose not less than No. 15 Stubbs' wire gage (.072″) nor greater than No. 13 Stubbs' wire gage (.095″).

f. Cement or other backing not to exceed No. 22 Stubbs' wire gage (.028″) in thickness.

Note.—For chemical and physical tests covering rubber lining, see Rules 11 and 12.

5. Diameter.

Internal diameter of hose shall be not less than 2½-inch, 3-inch and 3½-inch.

6. Couplings.

a. Internal diameter of couplings shall be not less than 2½-inch, 3-inch and 3½-inch.

b. To be made, finished and fitted in a workmanlike manner throughout.

c. To be of the expansion ring pattern and of the best form to resist the strain of expanding the binding ring in the coupling and must have a long tail part sufficient for expansion rings of the following lengths:

2½-inch not less than 1½-inch.
3 -inch not less than 1¾-inch.
3½-inch not less than 2¼-inch.

d. To be made of alloy of copper, tin and zinc (and lead if desired) of the following proportions:

Not less than 82% copper.
Not less than 7% tin.
Not more than 7% zinc.
Not more than 3% lead.

e. The weights of couplings to be not less than the following:

2½-inch not less than 5½ pounds.
3 -inch not less than 8 pounds.
3½-inch not less than 12 pounds.

f. To be stamped with the name or initials of the maker of the couplings and the month and year of manufacture in letters not less than ¼-inch high.

g. To be provided with rubber washers of best quality, accurately fitted.

h. To have a rubber washer in the coupling inside the expansion ring, to keep the end of the cotton fabric dry, and with inside diameter not less than that of coupling.

7. Weight and Flexibility.

a. The weight of 50 feet of finished hose, without couplings, to be within the following limits:

Single jacket:

2½-inch not more than 50 pounds.

Two jackets or plies, separate or interwoven:

2½-inch not over 60 pounds.
3 -inch not over 80 pounds.
3½-inch not over 110 pounds.

Three jackets or plies, separate or interwoven:

2½-inch not over 75 pounds.
3 -inch not over 100 pounds.
3½-inch not over 130 pounds.

b. For permissible weights with couplings attached add weights for couplings appearing in Rule 6.

c. Hose must be flexible and easily coiled.

8. Strength.

a. Samples three feet in length shall show average bursting pressure not less than the following:

Two jackets or plies, separate or interwoven:

When lying straight.....550 pounds.
When bent in a curve, the radius of which is 2¼ feet.....550 pounds.
With ends tied together and couplings touching and with a sharp kink in the middle..300 pounds.

Three jackets or plies, separate or interwoven:

When lying straight.....650 pounds.
When bent in a curve, the radius of which is 2¼ feet.....650 pounds.
With ends tied together and couplings touching and with a sharp kink in the middle..350 pounds.

b. Every length of hose shall be tested by the manufacturer, after coupling but before delivery, with 300 pounds pressure (to detect imperfections and insure proper attachment of couplings) and hose so tested to be stencilled in letters one inch high "Tested to 300 pounds." Hose to be carefully dried again before shipment.

9. Elongation.

a. The elongation between 10 and 100 pounds shall not exceed 4% (24 inches in 50 feet).

b. The elongation between 10 and 300 pounds shall not exceed 7% (42 inches in 50 feet).

10. Twist.

a. Any undue amount of twist is looked upon as showing inferiority in weaving. Hose to show but little tendency to twist at 100 pounds and up to 300 pounds the twist shall not exceed 14½° per foot of original length. (Equal to two turns in 50 feet.)

b. The hose shall not warp out of shape under pressure.

c. The twist to be in such direction as to tighten rather than loosen the couplings.

11. Chemical Tests on Rubber Linings.

a. The matter extracted by acetone shall not exceed four and one-half (4½) per cent. of the gum present.

It is to be noted that on 4½% of gum present free sulphur is not included.

b. The saponifiable matter extracted by alcoholic potash after acetone extraction test has been made, shall not exceed one (1) per cent. of the total compound.

c. The combined sulphur shall not exceed two and one-half (2½) per cent. of the total compound.

d. The mineral matter shall not exceed fifty-seven (57) per cent. of the total compound.

e. Sufficient pure rubber shall be used to show a balance of sample not less than thirty-seven and one-half (37½) per cent. of the total compound; this balance of sample to be obtained by subtracting

from 100% the per cent. of acetone extract, saponifiable matter, combined sulphur and mineral matter.

12. Physical Tests on Rubber Lining.

a. The breaking strength to be not less than eight hundred (800) pounds per square inch.

b. The length at the breaking point to be not less than five (5) times the initial length.

c. Place two marks two inches apart. Stretch to ten inches and hold in that position for ten minutes; ten minutes after release, the length shall not exceed 2¼ inches.

SPECIFICATIONS FOR THE CONSTRUCTION OF RUBBER HOSE FOR FIRE DEPARTMENT USE.

1. Size.

a. These specifications cover 2½-inch, 3-inch and 3½-inch hose.

b. When intermediate sizes are required, the following rules shall apply, provided, however, that finished hose and couplings shall have intermediate weights, and that the number of plies of duck shall be the same as for the next larger standard size.

2. Marking.

The name of the manufacturer and the month and year of manufacture, to be placed in prominent characters, and in a color which will contrast with that of the hose, twice in each 50-foot length; letters and figures showing date of manufacture to be not less than ONE-HALF INCH IN HEIGHT, and to be near the couplings.

3. Cotton Duck.

a. To be of selected long staple cotton, having the following minimum breaking strengths per inch:

Across filler threads not less than 300 pounds.
Across warp threads not less than 250 pounds.

b. To be of not less than the following number of plies:

2½-inch hose, 4-ply.
3 -inch hose, 5-ply.
3½-inch hose, 6-ply.

c. One additional ply in all cases to be provided at the ends where couplings are attached.

d. The weight of duck for 50 feet of hose to be within the following limits:

2½-inch not more than 25 pounds.
3 -inch not more than 32 pounds.
3½-inch not more than 40 pounds.

4. Friction Test.

All plies of cotton duck shall be united in a manner capable of withstanding the following friction test:

A strip one inch wide with a twenty (20) pound weight attached shall not separate at a rate greater than six (6) inches in ten (10) minutes.

5. Rubber Lining and Cover.

a. Shall contain not less than 40% of pure rubber and be free from any kind of rubber substitutes, old vulcanized or reclaimed rubber, or any other injurious adulterants. It shall be of uniform thickness and quality and free from defects throughout its entire length.

b. To be well and properly united to the plies of cotton duck so as to secure adhesion and durability.

c. The tubes to be made up of not less than three (3) calendered sheets, the intention being to remedy in three plies the defects that may occur in one or two.

d. Thickness of tubes to be within the following limits:
2½-inch and 3-inch hose not less than No. 17 Stubbs' wire gage (.058″) nor greater than No. 15 Stubbs' wire gage (.072″).
3½-inch hose not less than No. 15 Stubbs' wire gage (.072″) nor greater than No. 13 Stubbs' wire gage (.095″).

e. Thickness of cover to be within the following limits:
2½-inch and 3-inch hose not less than No. 21 Stubbs' wire gage (.032″) nor greater than No. 19 Stubbs' wire gage (.042″).
3½-inch hose not less than No. 19 Stubbs' wire gage (.042″) nor greater than No. 17 Stubbs' wire gage (.058″).

f. Ends of hose to be capped with ⅛ inch of rubber to protect duck against moisture.

6. Diameter.

Internal diameter of hose shall not be less than 2½, 3 and 3½ inches.

7. Couplings.

Internal diameter of couplings shall be not less than 2½, 3 and 3½ inches.

b. To be made, finished and fitted in a workmanlike manner throughout.

c. To be of the expansion ring pattern and of the best form to resist the strain of expanding the binding ring in the coupling and must have a long tail part sufficient for expansion rings of the following lengths:

2½-inch not less than 1½-inch.
3 -inch not less than 1¾-inch.
3½-inch not less than 2¼-inch.

d. To be made of alloy of copper, tin and zinc (and lead if desired) of the following proportions:

Not less than 82% copper.
Not less than 7% tin.
Not more than 7% zinc.
Not more than 3% lead.

e. The weights of couplings to be not less than the following:

2½-inch not less than 5½ pounds.
3 -inch not less than 8 pounds.
3½-inch not less than 12 pounds.

f. To be stamped with the name or initials of the maker of the couplings and the month and year of manufacture in letters not less than ¼ inch high.

g. To be provided with rubber washers of best quality, accurately fitted.

8. Weight and Flexibility.

a. The weight of 50 feet of finished hose, without couplings, to be within the following limits:

2½-inch not over 60 pounds.
3 -inch not over 80 pounds.
3½-inch not over 110 pounds.

Note.—If additional plies of duck are used for extra heavy duty, proportional increases in weights of finished hose shall be permissible.

b. For permissible weights with couplings attached add weights for couplings appearing in Rule 6.

c. Hose must be flexible and easily coiled.

9. Strength.

a. Samples three feet in length shall show average bursting pressures not less than the following:

When lying straight.....500 pounds.
When bent in a curve the radius of which is
2¼ feet.....500 pounds.
With ends tied together and couplings touching
and with a sharp kink in the middle.....300 pounds.

b. Every length of hose shall be tested by the manufacturer after coupling but before delivery, with 300 pounds pressure (to detect imperfections and insure proper attachment of couplings) and hose so tested to be stencilled in letters one inch high "TESTED TO 300 POUNDS."

10. Elongation.

a. The elongation between 10 and 100 pounds shall not exceed 3% (18 inches in 50 feet).

b. The elongation between 10 and 300 pounds shall not exceed 5% (30 inches in 50 feet).

11. Twist.

a. Any undue amount of twist is looked upon as showing inferiority in manufacture. Hose to show but little tendency to twist at 100 pounds, and up to 300 pounds the twist shall not exceed 7° per foot of original length. (Equal to one turn in 50 feet.)

b. The hose shall not warp out of shape under pressure.

c. The twist to be in such direction as to tighten rather than loosen the couplings.

12. Increase in Diameter.

Under a 300 pound pressure the increase in diameter of hose shall not exceed the following:

2½-inch hose not over ⅛ inch.
3 -inch hose not over 3-16 inch.
3½-inch hose not over ¼ inch.

13. Chemical Tests on Rubber Linings and Covers.

a. The matter extracted by acetone shall not exceed four and one-half (4½) per cent. of the gum present.

It is to be noted than on 4½% of gum present free sulphur is not included.

b. The saponifiable matter extracted by alcoholic potash after acetone extraction test has been made, shall not exceed one (1) per cent of the total compound.

c. The combined sulphur shall not exceed two and one-half (2½) per cent. of the total compound.

d. The mineral matter shall not exceed fifty-seven (57) per cent. of the total compound.

e. Sufficient pure rubber shall be used to show a balance of sample not less than thirty-seven and one-half (37½) per cent. of the total compound; this balance of sample to be obtained by subtracting from 100% the per cent. of acetone extract, saponifiable matter, combined sulphur and mineral matter.

14. Physical Tests on Rubber Linings and Covers.

a. The breaking strength to be not less than eight hundred (800) pounds per square inch.

b. The length at the breaking point to be not less than five (5) times the initial length.

c. Place two marks two inches apart. Stretch to 10 inches and hold in that position for 10 minutes; 10 minutes after release the length shall not exceed 2¼ inches.

NATIONAL STANDARD COUPLINGS.

Attention is called to the fact that a National Standard for fire department hose couplings has been determined upon, and endorsed by the National Board of Fire Underwriters, the National Fire Protection Association and other organizations interested in the subject. Wherever possible, it is advised that the National Standard threads be adopted.

USE OF LARGE HOSE.

It has been determined that 2½-inch couplings can be used on 3-inch hose and 3-inch couplings on 3½-inch hose without appreciable friction loss being introduced by the reduction of area at the couplings. The benefits of large hose can be obtained by pursuing this policy without necessitating several sizes of couplings.

SUGGESTIONS FOR CARE OF HOSE.

Fire department officials and those responsible for the care of hose are cautioned:

1st. To run water through all hose at least four times a year but to drain the hose carefully before stowing away again. With cotton jacketed hose allow fabric to dry thoroughly.

Note.—This applies particularly to small departments where hose receives infrequent use.

2d. To avoid keeping hose in warm rooms.

3d. To keep spare hose either stretched out or rolled up, avoiding as far as possible kinking or bending it. Slanting ventilated racks are advised.

4th. To test it once a year, to a pressure of 200 pounds where subject to considerable service, and in all other cases not less than 150 pounds.

Report of Committee on PUMPS.

E. V. FRENCH, Chairman,
31 Milk Street, Boston, Mass.

A. Blauvelt, L. W. Evans, F. H. Rice,
J. E. Curtis, F. E. MacKnight, R. Sweetland,
Gorham Dana, H. L. Phillips, Fitzhugh Taylor.
M. D. Pierce,

The following changes in the Rotary Fire Pump Specifications as amended at the 1907 annual meeting of the National Fire Protection Association are considered desirable, several of these having been suggested by one of the pump manufacturers.

TYPE A SPECIFICATIONS.

1. Article 5-a to read like the corresponding specification for steam pumps, namely, "Every pump must bear a conspicuous statement of its capacity securely attached to the inbored side of air chamber, thus:"

Also amend wording of plate to read, "Nominal capacity" instead of "Capacity."

This same suggestion would apply to the capacity plate for Type B pump under Article 5-a of Type B Specifications.

2. Article 5-a. Make the second paragraph a separate section, calling it "b."

3. 5-b. To read "5-c."

4. Article 8. Heading to read "Pump Casing," and Section "a" following to read "The cylindrical portions and the ends of pump casing to be of cast bronze," etc.

TYPE B SPECIFICATIONS.

5. Article 3-a, third fine-print note. Change "5.34" to read "5.83."

6. Article 12-b. Add the following: "Some means must be provided for preventing the gland nuts from jarring loose."

7. Article 13-c, fine-print note. Add "or the equivalent diametrical pitch."

8. 16-c. Amend second line of diameters in table to read for the respective pump sizes, "5" or 6", 6" or 8", 7" or 8", 8" or 10"."

Also fine-print note as follows: "Starting valve should be connected to the discharge casting at such a point that the water from the priming pipe will not run out through this starting valve when open."

Note.—The object of the change in the table is to permit the manufacturer at his option to make the openings for the hose connection piece the same size as for the main discharge, thus permitting the discharge pipe to lead away from the pump in any one of three different directions. This undoubtedly would be a considerable advantage under many conditions of pump installation.

9. 22-b. Amend to read like the similar specification for steam pumps as amended at 1907 meeting, namely, "The cone must be provided with an opening to receive the air-vent pipe, and the arrangement must be such," etc.

Additional suggestions for amendments of the rotary pump specifications have been received as given below, but at date of sending this report for printing in the "Quarterly" final conclusion regarding the several items has not been reached by the Committee, although the Committee may be able to report further information at the time of the forthcoming annual meeting.

Type B Specifications.

1. Article 11-a. Amend to provide for a more definite specification for the forged steel, as, for example, the Government specification for Class B forgings for United States Navy Department.

Also add specification for the steel castings similar to that adopted by the Government for Class B castings for United States Navy Department.

2. 13-a. Change to read: "Each pump gear must be of best forged steel or satisfactory steel castings. If of forged steel the gear should preferably be forged in one piece with the shaft."

Note.—It is claimed that much better steel castings are obtainable now than two or three years ago. It is thought, however, that this matter should be further investigated before action is taken on the suggested amendment.

3. 14-c. Change to read so as to include **planed** machined fits in addition to the **cylindrical** machined fits, or simply omit the word "cylindrical" from the present specification.

Note.—It is claimed that the object of this requirement can be obtained by removable and interchangeable square boxes, and that this construction under some conditions has certain advantages from the manufacturer's standpoint.

4. Article 26. Add a specification regarding the type of friction clutch to be used, that is, whether rim or face.

Note.—It is thought that the rim friction clutch should be used in preference to the face friction.

5. 14-e. Amend to require two ring oilers for each bearing and also to require for each cap four bolts at least ¾-inch in diameter.

6. 27-d. Amend to permit the use of machine-moulded gun-iron gears.

Note.—The manufacturer making this suggestion states: "For an installation driven by spur gears and clutch we feel that the use of cut gears is almost prohibitive as to cost in many cases, owing to the large gear required on the jack shaft. It would seem as if a machine-moulded gun-iron gear would be the proper thing for this case. A cut gear of cast iron in such sizes and pitches of teeth as it is practical to manufacture would not equal in strength the perfectly moulded gun-iron gears which it is possible to buy today."

Nothing has been brought to the attention of the chairman regarding the steam and centrifugal pump specifications which would seem to need special mention in such a report other than possibly what was included in the progress report printed in the January "Quarterly."

Report of Committee on
UNIFORM REQUIREMENTS.

GORHAM DANA, Chairman.
93 Water Street, Boston, Mass.

A. Blauvelt, J. M. Hughes, F. J. T. Stewart,
D. W. Canfield, C. S. Kremer, Alfred Stone,
C. M. Goddard, M. D. Pierce, W. S. Wensley.

Your Committee has attempted to make some minor improvements in the Uniform Requirements adopted by this Association and amended in 1906.

These changes have been largely along the lines of making the wording of different sections uniform, of simplifying the rules and of adding rules for certain matters not previously covered.

The subject of a glossary of insurance terms has been referred to this Committee but the Members feel that most of the words used in the insurance business are already properly defined in dictionaries and that most of the words where there is question, are architectural terms that could better be defined by some architectural organization. On this account and owing to the great difficulty of obtaining any agreement amongst the Members of our Association on most of the definitions, we recommend that the subject be indefinitely postponed.

The Committee suggest that they be authorized to prepare a standard for "joisted" or "sub standard" buildings.

Referring to the Uniform Requirements pamphlet, 1906 edition, we recommend the following changes:

Note—The following are recommendations from the standpoint of the Fire Underwriters only and are in no way intended as a guide to architects or mill engineers with reference to the strength which any building may require due to size or occupancy.

1. FOUNDATIONS.

   a. Foundation walls to be of Portland cement concrete, hard burned brick laid in Portland cement mortar, or stone laid in Portland cement mortar.

Note.—In certain cases where soil is dry natural cement can sometimes be used with satisfactory results.

   b. If built of concrete or rubble stone, to be at least 8″ thicker than wall next above. If built of squared stone or brick, to be 4″ thicker than wall above.

   c. To extend to a safe distance below frost line and in no case less than 4′ below level of ground.

2. OUTSIDE WALLS.

   a. To be of good hard burned brick laid in best cement, or lime and cement mortar.

Note—No iron, stone, or any material other than brick to be used in wall construction.

b. All exposed walls to be carried at least 3′ above roof and provided with a durable coping, all openings in same to be protected with standard shutters, fire doors or wired glass windows.

Note—A fire wall with window openings protected with shutters is not as good as a blank wall. Where wired glass is used care should be taken that there is no combustible material near window that could be set on fire by radiation. Underwriters having jurisdiction should be consulted before installing shutters or wired glass windows. Open sprinklers may be allowed in certain places as a protection against exposure.

c. Bearing walls to be not less than 12″ thick for top story and increased 4″ for each additional story or fraction thereof, the ledges thus formed acting as supports for the floor timbers. Walls may be corbelled out to support timbers where necessary. If walls are of pier construction, piers to be well laid and flushed up full with mortar and graded in size according to weights to be carried, but not less than 20″ thick for the upper two stories, increasing 4″ for each story below and graded in width of face according to span of bays, the face of pier to measure not less than one-fourth as much as the space between centers. Walls between piers to be not less than 12″ thick.

d. Non-bearing walls to be not less than 12″ thick for the three upper stories, 16″ thick for the next three lower stories and 20″ thick for the stories below.

e. At window and door openings, walls above to be self-supporting without the use of lintels. Sills to be iron, brick, or concrete.

f. Bearing walls not to have flue, window or other openings in excess of 45 per cent. of the total wall area on each floor.

g. All walls over 105′ in length, between cut-off, division or party-walls to be increased 4″ in thickness or strengthened by pilasters as specified under 2 c.

h. Walls over 16′ high shall be increased 4″ in thickness for each 12½′ of span over 25′ unless party-walls, piers or columns equivalent thereto intervene.

3. CUT-OFF, DIVISION OR PARTY-WALLS.

a. To be of same material as outside walls. See 2 a.

b. To be at least 3′ parapet, and not less than 12″ thick, projecting to cut off overhang in roof if any; metal roofing must not be carried over fire walls, and a non-combustible durable coping to be provided. Special provision to be made regarding parapeting where monitors or roof lanterns are near cut-off walls.

c. Bearing walls to be not less than 12″ thick for the two upper stories, and to be increased in thickness 4″ for each additional story or fraction thereof, the ledges formed acting as supports for the floor timbers, and where timbers enter walls,

they shall rest on iron plates and be practically self-releasing. Walls may be corbelled out to support timbers where necessary.

If walls are of pier construction, piers to be well laid and flushed up full with cement or lime and cement mortar and graded in size according to weights to be carried, but not less than 20″ thick for the two upper stories, increasing 4″ for each story below, and graded in width of face according to span of bays, the face of pier to measure not less than one-fourth as much as the space between centers. Walls between piers to be not less than 16″ thick.

d. Non-bearing walls to be not less than 12″ thick for the three upper stories, 20″ thick for the next three lower stories and 24″ thick for stories below.

e. Where wood beams enter walls at opposite sides, there must be at least 12″ of brickwork between ends of beams and in no case shall they enter more than one-quarter the thickness of the wall.

f. All door openings to be protected by standard automatic fire doors (sliding doors preferred) on each side of the wall. Doors to be kept closed nights or when not in use. All openings such as shafts and belt holes, etc., to be avoided where possible and where present, to be protected in an approved manner by standard shutters.

g. All window and other openings in side walls of building, for a distance of 8′ each side of fire wall, to be protected as called for in Section 2 b.

h. Where main cut-off sections adjoin so as to form an angle, all window or other openings in side walls for a distance of 30′ from angle to be protected as called for in Section 2 b. Where minor sections, such as boiler or engine house adjoin, the above rule need apply to main sections of building only. Where there are no openings in one section, the other section need not be protected.

i. Where buildings of different heights adjoin all the windows of the higher section above roof of and within 8′ either side of lower section to be protected as called for in 2 b.

4. ROOFS.

a. To be of plank and timber construction and flat except for pitch necessary for proper drainage.

Plank to be not less 2½″ (2¼″ dressed) splined or tongued and grooved.

Timbers to be not less than 6″ either dimension.

Both roof timbers and planks to be practically self-releasing as regards walls.

b. All exposed woodwork to be planed smooth.

c. Covering to be of metal, gravel or approved composition.

5. SKYLIGHTS.

To be built according to rules of the National Board of Fire Underwriters.

6. CORNICE.

If any, to be of brick or incombustible material. No wood or other combustible material to be used in attaching cornice to wall.

Note—Overhanging plank cornice resting on roof timbers is not considered to be as satisfactory as a non-combustible cornice, but its use would not be seriously objected to where not exposed by other buildings.

7. FLOORS.

a. To be solid and without openings except as hereinafter provided.

b. To be not less than 3" (2¾" dressed) splined or tongued and grooved plank covered with 1" (¾" dressed) flooring laid crosswise or diagonally with two thicknesses of carefully laid approved waterproof material between floors. This material to be flashed at least 3" at the walls and around all columns and openings with moulding or mopboard.

c. To rest on single stick timbers.

Note—Double stick timbers with space between them are considered very undesirable. If it is found necessary to use double sticks the space between them should be completely filled in.

Floor timbers to be suitable for the load carried, but in no case less than 6" either dimension, timbers to rest on iron plates on wall ledges and where entering walls to be practically self-releasing. Walls may be corbelled out to support timbers where necessary.

Width of bays to be between 6 and 11'.

Note—Bays from 8 to 10' are preferred.

d. All exposed woodwork to be planed smooth.

e. Basement floor may be cement or any non-combustible material if preferred.

f. Any pipes or conduits extending through floor to be fitted with metal thimbles and made watertight to a distance of 3" above floor.

g. Floors, including basement floor, to be arranged to drain to elevator well or some other point where minimum damage will result from water.

Note—It is recommended that where feasible, floors be built with a slight pitch (about 1" to 20') and have proper scuppers or drain pipe.

8. POSTS.

a. To be of timber and to be proportioned in size according to the weights to be carried. The smallest cross sectional dimensions to be not less than 6" and all corners to be rounded or chamfered. To be superimposed throughout all stories with ends connected by properly designed cast iron caps (practically self-releasing as regard floor timbers) with cast iron pintle and base plate.

b. Exposed surfaces to be planed smooth.

Note—Heavy machinery should not be bolted to walls or posts.

9. FINISH.

No wood or other combustible finish to be used. A non-combustible finish without concealed space may be used.

Note—A limited amount of wood finish without concealed spaces will not be objected to in offices, etc. Shellac or varnish finish is objectionable.

10. STAIRWAYS AND ELEVATORS.

a. To be enclosed in brick shafts at least 8″ thick and walls containing doorways to be at least 12″ thick. Walls of shaft to pierce all floors and extend 3′ above roof.

b. Standard single automatic fire doors to be installed in all openings to building.

c. Shafts to be ventilated by ordinary thin glass windows opening outside (and not exposing windows in building itself) or by thin glass skylight protected by standard wire netting, as provided in rules of the National Board of Fire Underwriters. Skylight can have a wire glass top with thin glass sides.

d. There should be a 3′ drainage pit at the bottom of the stair tower or elevator shaft connected with sewer or satisfactory well to carry off water coming from upper floors.

11. PARTITIONS.

a. To be constructed of non-combustible material or of 2″ matched plank or double matched board with joints broken, preferably coated with fire retarding paint.

Note—Ordinary paint is not objectionable, but varnish or shellac is very undesirable.

12. AREA.

"Area not to exceed 5,000 square feet per fire section where building is not equipped with sprinklers."

Note—By fire sections is meant a section either cut off by standard fire walls, as provided in Sections 2 and 3, or separated from all exposing buildings by a distance equal to at least the sum of the heights of the two buildings in question, but this distance should never be less than 50′ and need ordinarily never be over 150′.

13. HEIGHT.

"Height not to exceed 5 stories or 65′ above average ground level."

Basement, if over 3′, measured from bottom of floor girders to ground above average ground level, to be counted as a story.

14. HEATING.

To be steam or hot water. Pipes to be properly bushed where passing through woodwork, and to be properly supported and kept away from woodwork. To be properly spaced where flyings are liable to lodge. The overhead method of steam piping is preferred.

Note—Hot air systems of heating as ordinarily installed are not

considered as safe as steam or hot water. Underwriters having jurisdiction should be consulted if it is desired to install hot air system.

15. BOILER.

To be in a 1-story brick building either detached at least 25′ or with exposed or adjoining walls treated as fire walls, as specified in Section 2 and 3. Floor to be non-combustible.

Note—"Roof of fireproof construction is recommended for boiler house and in this case, wall above boiler house roof need not be made a fire wall."

16. STACKS, CHIMNEYS AND FLUES.

All chimneys to be of brick with joints struck smooth on inside and provided with hard burned tile flue lining. Walls of flues and chimneys from high pressure boilers or furnaces to be not less than 12″ thick and the inside 4″ shall be of fire brick laid in fine mortar for a distance of 25′ in any direction from source of heat. Air spaces to be provided in chimney walls where conditions render it necessary.

"Flue walls, exclusive of lining, to be not less than one half the thickness of building wall at each story."

17. UPTAKES FROM HIGH PRESSURE BOILERS.

To be not less than 3′ from all timbers or other woodwork.

Note—Unless there is a clearance of 6 to 8′ between flue or boiler and roof it is recommended that boiler room be provided with ventilators.

18. POWER.

a. If steam or electricity, the engine or dynamos to be located in a one-story section cut off as specified in Section 3. All electric work to be installed in conformity with National Electric Code.

b. If water, wheels may be located in main building.

c. All belts or rope drives used to transmit power from floor to floor to be located in a belt tower. Tower to be cut off from main building as specified in Section 10 and walls to extend through roof at least 3′. Shaft holes through walls to be protected with standard shutters.

19. LIGHTING.

a. To be by approved electric or gas systems.

b. If electric, to be installed in accordance with the National Electric Code.

c. If gas, jets to be "of stationary type and burners to be at least 2½′ below ceiling, burners to be provided with suitable tips."

CLASS B.

Inserts or Changes are in bold faced type.

20. To read, "If not fastened direct to studding or joists, i. e. if there are any spaces from one stud or joist channel to another,

sheathing to be entirely removed, or reconstructed without such openings."

21. Make this section 20d. Leave out, "Preferably the latter" and add, **or its equivalent.**
22. Make this 20e.
24. Omit "Alternatives a, b and c."
24b. To read "Boxed cornices **not cut off by** the roof timbers to have 2-inch plank or **non-combustible stops** placed at intervals not exceeding 30 feet.
25. **Skylights.** "To be **protected by netting or fitted with wired glass** in accordance with the rules of the National Board of Fire Underwriters. (See rules for Skylights, Class A, Section 13, etc.)
26. **Elevators.** Make this 27a.
27. Make this 26b. Omit "etc."
27c. Add a new section reading, **"To be enclosed in double board partition, the two layers to be at different angles, with doors of the same or equivalent material at each opening. No windows, except wire glass, properly set, to be allowed in enclosure. Interior to be painted with fire resisting paint.**

Note.—This method is not the equivalent of the preceding and should not be used unless there is a special need for it. It should be allowed only when sprinklers can be installed inside as per sprinkler rules.

33. **Fire Doors.** "To be **built and installed** in accordance with the rules of the National Board of Fire Underwriters. To be placed in all door openings in fire walls as follows:".....
Also two new sections to be added as follows:
b. **Doors to be double, i. e., one on each side of opening in the following places.**
c. **Doors in the following places to be fitted with approved automatic closing devices.....**
34. **Shutters.** "To be **built and installed in accordance** with the rules of the National Board of Fire Underwriters. **To be located as follows.....**
35. **Wired Glass Windows.**
a. To be **built and installed according to the rules of the National Board of Fire Underwriters. To be located as follows.....**
b. **To be of an approved automatic type in the following places.**

CLASS C.

Omit this section as it is included under Class A.

50. Watchman.
a. To be maintained nights, Sundays and holidays and at all other times when plant is not in operation. **"First round to be begun immediately after operations at plant are suspended and continued until the arrival of such persons or person as shall relieve him of his responsibility."** Rounds to be made at least every hour nights and every two hours during the daytimes.

b. **Watchman to record on approved central station system.**
c. **Watchman to record on approved watch or clock. Dials to be changed daily unless clock is arranged to register distinctly for more than a 12 hours period.** Dials to be dated and kept on file for inspection.
d. There shall be a sufficient number of stations to insure watchman visiting all portions of risk. Same to be located under the supervision of the underwriters having jurisdiction.
e. Wiring and all other matters pertaining to systems or system to be installed according to the rules of the National Board.
f. Watchman to be employed for watching the plant only.

51. Change heading to **Thermostats.**
Change remainder as follows:
To be of an approved type.
To be installed according to the rules of the National Board of Fire Underwriters.
To be connected to.....

CLASS E.

60. **To be constructed and installed according to the rules of the National Board of Fire Underwriters.**
61. **"Sand Pails.** Pails of dry sand (with scoop) to be provided where oils, varnishes, etc., are used," **as follows**.....
62. Cleanliness.
a. To be satisfactorily maintained, especial attention being given to nooks and corners, space under benches, care of oily waste, shafting, blower journals and disposition of sweepings.
b. **Waste Cans, Ash Cans, Refuse Barrels and Safety Cans to be constructed and installed according to the rules of the National Board of Fire Underwriters. To be located as follows**.....
63. Omit and substitute.
"Excelsior and Other Packing Materials."
a. **Not over one day's supply to be kept on hand.**
b. **Surplus to be stored in fireproof or tin lined box of a capacity not exceeding 64 cubic feet. If of wood, to be not less than ¾ inch thick and lined with lock jointed tin. Tin to extend at least 2 inches over edge of both opening and cover. Cover to fit closely and to be self closing.**
64. Add paragraph.
"To cover the following points: Condition of valves, dry systems, alarm valves and connections, gravity tank, pressure tank, steam pump and automatic regulator, rotary pump, sprinkler heads, fire pails, chemical extinguishers, fire doors and shutters, hydrants and hose houses, elevator and stairway and trap doors, open sprinklers, watchman's records and thermostat dials cleanliness.

69. Standpipe and Hose.
   a. Standpipes of a diameter not less than.....inches to be installed as follows.....
      To be connected to the following water supply.....
      To be fitted with.....feet of.....inch hose at each floor.
   b. Small hose to be connected to sprinkler system, same to be installed according to the rules for automatic sprinkler systems of the National Board of Fire Underwriters. To be located as follows.....

CLASS F.

70. Automatic Sprinklers.....pipe system to be installed according to the rules of the National Board of Fire Underwriters. To cover.....
71. Protection Against Corrosion. Sprinkler heads to be properly coated with an approved coating and sprinkler pipes to be of galvanized iron or given at least two coats of satisfactory protective paint in the following places.....
72. Public Water Supply. "Sprinkler system to be connected with" .....main in.....street "through not less than.....inch pipe." Also with.....main in.....street through not less than.....inch pipe.
73. Substitute constructed for "arranged" 5th line. Add, and to be located after National Board of Fire Underwriters. Omit section b and insert this in sprinkler rules.
74. To be constructed and installed according to the rules of the National Board of Fire Underwriters.
    Capacity to be not less than.
    To be located.....

75a. A National Standard Steam Pump constructed and installed according to the rules of the National Board of Fire Underwriters to be provided.
    Capacity to be not less than.....gals. per minute.
    To be located.....
    To draught from.....
76. Make this 75b.
77. Make this 75c and make it read,
    Automatic Regulator. An automatic regulator constructed and installed according to the rules of the National Board of Fire Underwriters to be provided. To be set to maintain..... pounds pressure.
    Add a new section,

75d. An Auxiliary Pump to be provided and installed according to the rules of the National Board of Fire Underwriters. To be set to maintain.....pounds pressure.

78. Rotary Pump. A national standard type.....rotary pump constructed and installed according to the rules of the National Board of Fire Underwriters to be provided.
    Capacity to be not less than..... gallons per minute.
    To be located.....
    To draught from.....

79. **Alarm Valves.**
   a. **An alarm valve of** "approved type to be installed in"
   b. **To be connected to water rotary gong on building. Gongs to have suitable hood for protection against weather.**
   c. **To be connected to.....inch electric bell in.....wiring to be installed according to rules of National Board of Fire Underwriters.**
   d. **To be connected to electric bell in central station.**
   e. **To have approved testing device with which daily tests shall be made and recorded. Records to be kept on file.**

80. **"Dry Valve."**
   a. Dry valve of approved type to be installed in accordance with the rules of the National Board of Fire Underwriters. To be fitted, (see paragraph 2, 80a).
   b. **To be connected to water rotary gong on building. Gong to have hood to protect it from weather.**
   c. **To have electric circuit closer connected to gong in central station.**
   d. **To have electric circuit closer connected to gongs in following places.....**
   e. **To have approved alarm gage connected to bell in.....**

81. Omit. This is now covered in sprinkler rules.
82. do. do.
83. **"Post Indicator Gate Valves."** "To be of approved type **and to be located.....**
85. Omit. Covered by Sprinkler Rules.
87. **Coat Closets.**
   a. **Coat closets to have wooden tops removed. Thin cloth or paper may be substituted and top to be made slanting.**
   b. **Shelves to be set away from sides or perforated with holes so as to obstruct the passage of water as little as possible.**

91. **"Hydrants."**
   a. **To be constructed according to the rules of the National Board of Fire Underwriters.**
   b. **To be.....way.**

92. Insert **and equipped** after "constructed" line 1.
Change "specifications" to **rules,** line 2.

CLASS I.

Rules for the **enclosing of** Stairways.

CLASS J.

Include this under Class I.

CLASS H.

Change heading to **"Rules for Enclosing and Trapping Elevator and Stairway Openings."**
Then include classes I and J under H.

95b. "If floor is of ordinary **joisted** construction or not more than 1½ inches thick, the **traps shall be made at least ⅞ inch thick.**
   c. Omit "standard" line 3.

96. Automatic Trap doors for Stairways or **"Elevators."**
   d. Insert **"For Stairway Openings."**
   e. Insert **"For Stairway Openings."**
   Also add new section,

f. "For Elevator Openings:

All traps to close automatically by fusible link or electric attachments, so arranged that all traps on one shaft will be operated by the fusing of any one link or thermostat. All wires, chains and pulleys to be protected, where necessary, against mechanical injury by substantial guard strips, or from being rendered inoperative by piling stock or other material against same. All weights to be enclosed if outside of shaft and so arranged that one side of boxing can be easily removed for accessibility. Traps to be provided with automatic flaps for covering all cable, guide and counterweight openings when same are closed; a spring must be put on the back of all flaps for closing same when the traps are released."

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